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see overleaf

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Paper Chromatography

Paper chromatography is a method for the separation and identification of minute amounts of chemical substances. To carry out a separation, the scientist places the mixture, for example, a biological extract, near the edge of a piece of filter paper and dips the edge into a suitable solvent. The solvent gradually passes over the mixture and carries the individual components of the mixture, depending on their solubility, a certain distance on the paper. Complicated mixtures are thereby separated into individual components and their identity can be established by comparison, under similar conditions, with known chemical compounds. The position of colorless substances on the paper may be revealed by the use of a suitable color reagent.

Paper chromatography has proved to be of tremendous value in solving a large variety of research problems. Amino acids, sugars, vitamins, and hormones have been identified and measured in various biological extracts. At the National Institutes of Health, methods based on paper chromatography have been developed to permit the identification and measurement of minute quantities of steroids, including the steroid hormones.

Steroids of pharmacological interest, for example, a raw material for the synthesis of cortisone, occur in various plants and especially in the seeds of certain rare African plants. An expedition, sponsored by the National Institutes of Health and the Department of Agriculture, collected seed specimens in Africa. The seeds were analyzed by scientists using the paper chromatography technique at the National Institutes of Health. Those seeds which showed promise for pharmaceutical purposes are being used by the Department of Agriculture for cultivation in the United States.

frontispiece

A technician of the National Institute of Arthritis and Metabolic Diseases, Public Health Service, sprays a chromatogram with reagent as a step in the process of paper chromatography.

Contents for August, continued

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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PUBLIC HEALTH SERVICE
LEONARD A. SCHEELE, *Surgeon General*

Geographic Study of Cancer Prevalence Within an Urban Population

By MARY ELLEN PATNO, M.Sc.

Differences in the distribution of cancer morbidity within 16 homogeneous areas in Pittsburgh, Pa.

THE ANALYSIS described here resulted from the question, "Is cancer uniformly distributed among an urban population?" Or conversely and more specifically, "Are there geographic differences in the prevalence of cancer within given age, sex, and racial groups of an urban population?"

An opportunity to consider such a question has been provided through data collected by the Public Health Service in 1947 and made available for study to the department of biostatistics of the Graduate School of Public Health, University of Pittsburgh. The method of collecting the data and findings with respect to cancer morbidity and mortality among residents of Pittsburgh has been described in the publication, Cancer Illness Among Residents of Pittsburgh, Pennsylvania (*1*).

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Selection of Geographic Areas

The courses of the Allegheny, Monongahela, and Ohio Rivers provide three natural subdivisions of the city of Pittsburgh, each with areas of low, medium, and high socioeconomic status. Therefore, it was decided to subdivide the three larger areas into smaller ones which might have greater socioeconomic homogeneity. The smaller areas were formed by adding together contiguous census tracts which resembled each other in (*a*) median income (1949) of white families and unrelated individuals, (*b*) percentage of nonwhite population, and (*c*) percentage of employed white men classified as craftsmen, foremen, and kindred workers, as operatives and kindred workers, and as laborers, except in mines. The data used were those of the 1950 census (*2*).

Sixteen smaller areas were obtained, ranging in population from 17,000 white individuals to 54,000. Within these areas, the median

income among white families ranged from $1,610 to $4,350, compared to a median income of $3,061 for white families within the city. In 1950, nonwhite individuals made up 12.3 percent of the city's population. Similar figures for the 16 areas ranged from 0.3 percent to 59.8 percent. In the same year, 53.5 percent of the city's employed white men were classified as craftsmen, operatives, laborers, and kindred workers. Among the areas, as few as 19.8 percent of the employed white men were so classified, and at the other extreme as many as 68.9 percent.

Population Base

While the cases of cancer were reported by single years of age, the only available census tract population data were by 5-year age groups for the years 1940 and 1950. Therefore, the 1947 population estimates which were obtained by averaging the two censuses were considered as the population bases for such age groups as 7–26, 27–46, and so forth, and the cases were compiled accordingly. For example, in each area, the 1940 census figure for white men in the 20–39 age group was averaged with the 1950 figure for white men in the ages 30–49, and the result was used as the 1947 population base for white men aged 27 through 46.

Method of Analysis and Results

A glance at the age-sex specific prevalence rates in tables 1 and 2 reveals that reported cases were not distributed uniformly throughout the 16 areas. For example, among white men in the 47–56 age group, the prevalence rate per 100,000 ranged from 358 (in area 11) to 1,032 (in area 1), and the city rate was 675. White women in this same age group throughout the city experienced a prevalence rate of 1,072 per 100,000, but the rates of the several areas ranged from 607 (in area 15) to 1,474 (in area 2).

The geographic variation in the distribution of cancer in Pittsburgh may be summarized in two successive stages. The first is the comparison of the "age-standardized" rates for the white population of the 16 areas. These rates are ranked in table 3, and each area is designated according to its rank. For example, the area with the highest rate has been called area 1; that with the lowest, area 16.

Tests for homogeneity showed that the variations seen in table 3 were extremely unlikely to have been due to "sample variation." For each of the three groups (total white population, white males, and white females), the probability that the rates could have come from a universe which experienced the city's rate was less than .001.

As a second stage in describing the differences among the several areas, the rate of each of the

Table 1. Population and cancer prevalence per 100,000 population for 16 small areas within Pittsburgh, 1947—white males

Area	Age group				
	7–26 years	27–46 years	47–56 years	57–66 years	67 years and over
	Population				
City	89,012	91,226	38,064	29,167	21,637
1	5,322	5,226	2,519	2,395	1,661
2	6,462	7,200	3,623	2,556	1,809
3	4,926	5,728	2,427	1,824	1,533
4	3,120	3,705	1,769	1,284	943
5	2,475	2,692	1,260	893	672
6	7,049	6,998	2,534	1,919	1,219
7	8,551	9,022	3,839	2,532	1,905
8	7,077	6,730	2,668	1,965	1,518
9	5,450	4,989	1,904	1,482	1,177
10	5,708	5,873	2,508	1,961	1,536
11	5,946	5,676	2,236	1,772	1,376
12	8,448	8,074	2,886	2,342	1,596
13	6,889	6,837	2,443	1,868	1,272
14	4,383	4,378	1,880	1,310	1,062
15	3,992	4,756	2,374	2,080	1,646
16	3,214	3,342	1,194	984	712
	Rate				
City	27	180	675	1,617	2,505
1	56	306	1,032	1,921	3,432
2	31	194	497	1,956	3,483
3	20	175	824	1,973	1,957
4	32	162	509	1,713	2,969
5	40	149	476	2,128	3,125
6	14	143	829	1,667	3,117
7	12	166	599	1,303	2,257
8	28	193	600	1,323	1,910
9	37	180	578	1,552	1,699
10	17	238	678	1,173	2,083
11	17	128	358	1,749	1,962
12	12	149	520	1,110	2,130
13	14	146	573	1,124	2,987
14	23	114	745	916	1,695
15	25	147	716	1,298	1,458
16	0	30	586	1,524	1,404

Table 2. Population and cancer prevalence per 100,000 population for 16 small areas within Pittsburgh, 1947—white females

Area	Age group				
	7–26 years	27–46 years	47–56 years	57–66 years	67 years and over
	Population				
City	92, 314	99, 789	38, 509	28, 980	24, 925
1	5, 360	5, 183	1, 814	1, 426	1, 152
2	6, 990	9, 606	4, 070	2, 912	2, 471
3	5, 378	6, 964	2, 744	2, 162	2, 070
4	3, 208	4, 798	2, 139	1, 731	1, 555
5	2, 610	3, 291	1, 360	1, 040	811
6	7, 366	7, 143	2, 470	1, 786	1, 462
7	8, 793	10, 083	3, 907	2, 724	2, 288
8	7, 402	7, 264	2, 694	1, 959	1, 722
9	5, 328	5, 264	1, 970	1, 503	1, 316
10	5, 789	6, 435	2, 798	2, 146	1, 902
11	6, 166	6, 144	2, 363	1, 880	1, 740
12	8, 860	7, 997	2, 818	2, 091	1, 679
13	6, 902	7, 025	2, 456	1, 709	1, 336
14	4, 458	4, 707	1, 894	1, 450	1, 210
15	4, 526	4, 963	1, 976	1, 628	1, 505
16	3, 178	2, 922	1, 036	833	706
	Rate				
City	41	345	1, 072	1, 750	2, 058
1	131	405	1, 323	2, 104	2, 604
2	57	593	1, 474	2, 438	2, 307
3	37	388	1, 385	2, 313	2, 850
4	62	542	1, 262	1, 502	2, 508
5	115	243	1, 250	1, 923	2, 219
6	14	308	931	1, 680	1, 710
7	34	228	947	1, 322	1, 792
8	13	248	1, 039	1, 940	2, 265
9	0	209	964	1, 929	2, 204
10	0	218	679	1, 538	1, 893
11	32	325	931	1, 383	1, 034
12	23	313	958	957	1, 727
13	58	142	692	995	1, 796
14	67	276	634	1, 448	1, 405
15	0	262	607	1, 044	1, 262
16	63	137	676	1, 441	991

16 areas has been compared with the corresponding rate for the remaining 15 areas combined and the difference examined in terms of the variance of the difference. When the prevalence rate of an area was greater than that of the combined remaining areas by an amount that exceeded the 5-percent level of significance, it was called "high." When an area's rate was less than that of the combined remaining 15 areas by the same amount, it was called "low." The areas regarded as having high or low rates and their levels of significance are shown in figures 1–4. Prevalence by age groups is shown in figures 1 and 2, and prevalence by primary site is shown in figures 3 and 4. The areas not shown differed from the city as a whole, but the differences were small or assumed to be due to sample variation. This second procedure points to high prevalence rates for the white males and females of area 1 and for the white females of area 2. The prevalence rates of areas 15 and 16 are low for both sexes.

High or Low Prevalence Areas

The discussion of areas within Pittsburgh will be directed principally to the two (areas 1 and 2) with the highest overall prevalence rates and the two (areas 15 and 16) with the lowest. From several points of view, area 1, consisting of the "downtown" and "hill" sections, can be considered toward the bottom, if not at the bottom, of the socioeconomic scale. On the other hand, area 2 is very close to the top of the scale. Both areas, however, experienced high prevalence rates.

Area 15, consisting of portions of the central and eastern sections of the "north side" of Pittsburgh, and area 16, consisting of Manchester and Woods Run, are the second and third lowest areas in economic status. Although similar to

Table 3. Cancer prevalence per 100,000 population in 16 areas comprising Pittsburgh, and for the city as a whole, 1947

Area	Total white population	White males	White females
1	780. 1	752. 9	805. 9
2	761. 0	638. 8	876. 6
3	690. 9	553. 7	820. 7
4	660. 6	561. 9	753. 9
5	648. 6	613. 1	682. 2
City	591. 4	542. 2	637. 9
6	580. 2	602. 0	559. 5
7	567. 5	627. 6	510. 7
8	544. 8	456. 7	628. 1
9	528. 5	460. 0	593. 3
10	484. 1	477. 1	490. 7
11	465. 1	447. 0	482. 2
12	458. 6	419. 5	495. 6
13	458. 3	497. 6	421. 1
14	432. 4	387. 2	475. 2
15	403. 9	417. 3	391. 2
16	382. 8	371. 2	393. 6

NOTE: Rates are standardized for age on the total population of Pittsburgh, 1947.

Prevalence of cancer among white men and women, by age, in 16 areas of Pittsburgh, 1947.

Figure 1. White men.

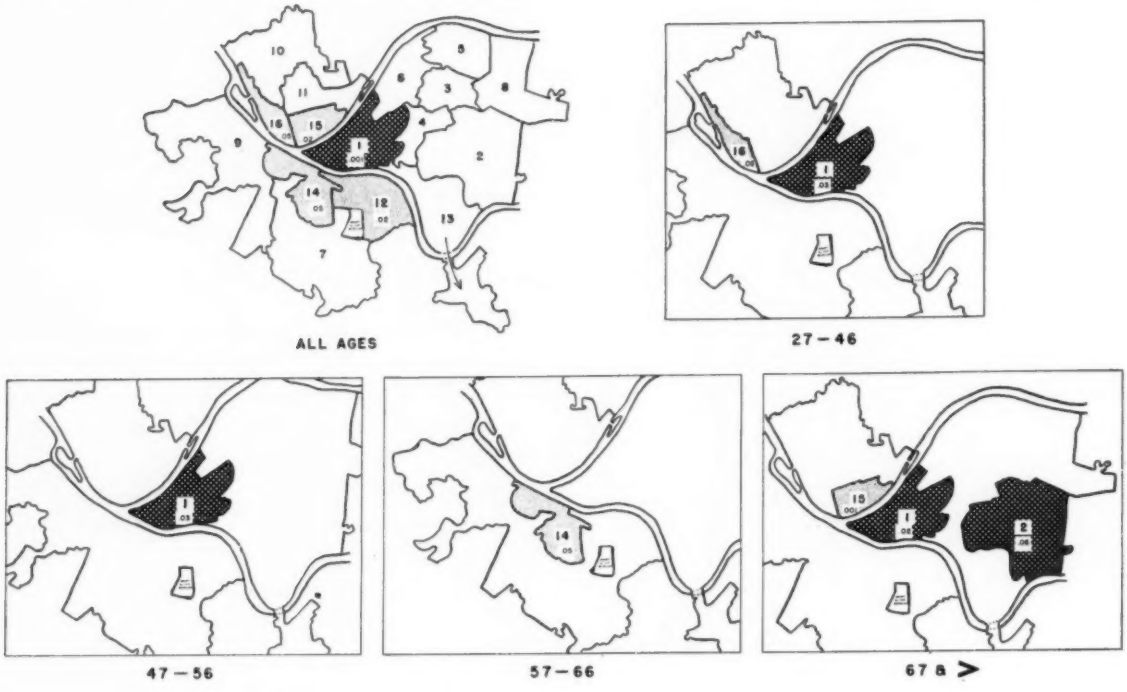
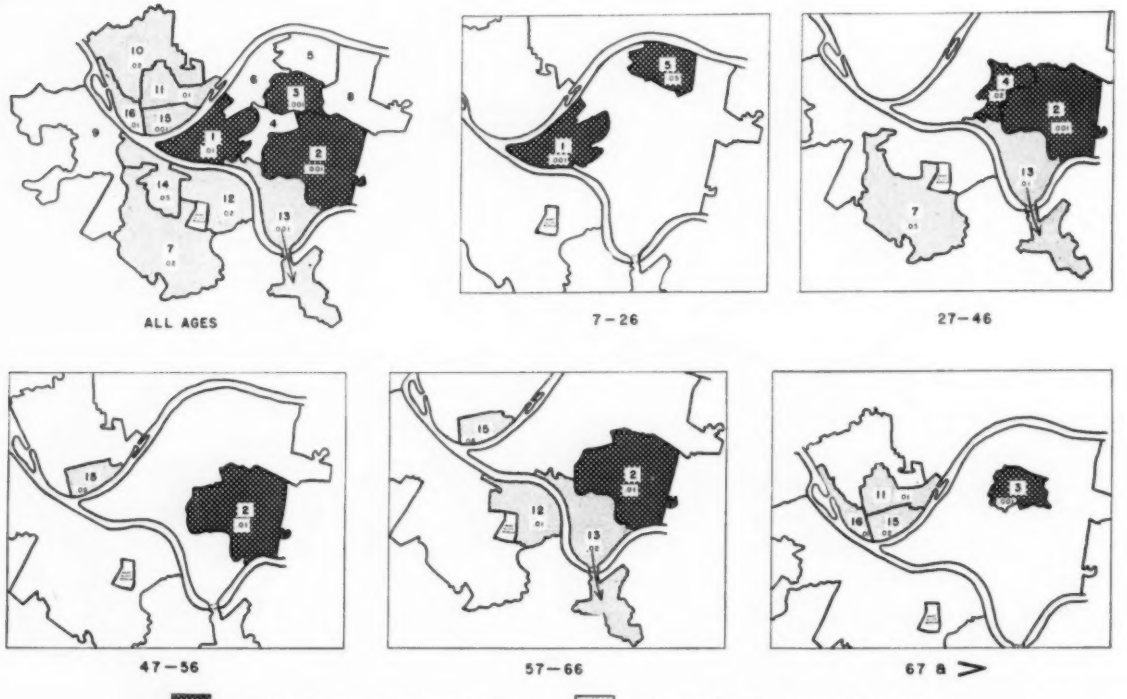


Figure 2. White women.



NOTE: Levels of significance are shown within study areas, which are designated by number. "All ages" refers to all persons in the study group, which did not include those of unknown age or under 7.

Prevalence of cancer among white men and women, by site, in 16 areas of Pittsburgh, 1947.

Figure 3. White men.

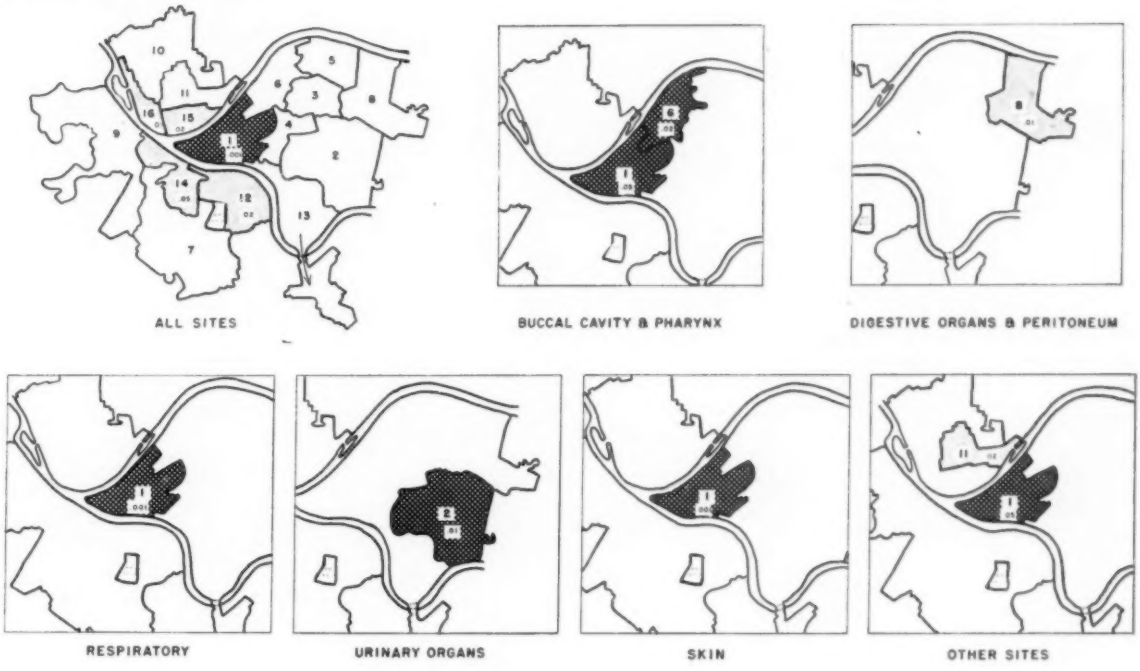
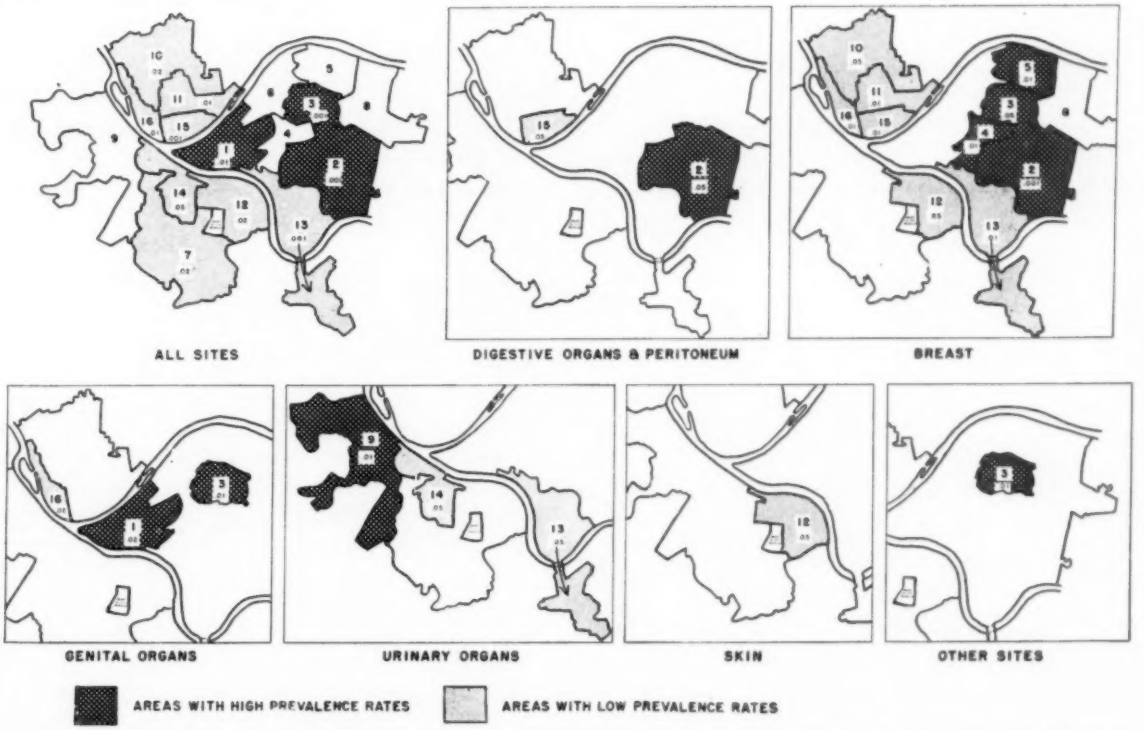


Figure 4. White women.



NOTE: Levels of significance are shown within study areas, which are designated by number. "Other sites" includes cancer of the brain, central nervous system, endocrine glands, bone, eye, soft tissues, and other leukemias and lymphomas.

Table 4. Selected demographic characteristics of Pittsburgh for areas 1, 2, 15, and 16

Characteristics	City	Area 1	Area 2	Area 15	Area 16
Median income, 1949, among white families and unrelated individuals	$3,061	$1,610	$3,721	$2,418	$2,610
Percentage of employed white men classified in 1950 as:					
Craftsmen, foremen, kindred workers	21.9	15.7	9.9	21.5	21.1
Operatives and kindred workers	20.0	18.6	7.1	23.2	29.2
Laborers, except mine	11.6	17.7	2.8	17.0	18.6
Total	53.5	52.0	19.8	61.7	68.9
Percentage of nonwhite population, 1950	12.3	59.8	1.5	1.8	19.5
Percentage of foreign-born population, 1950	10.9	17.2	13.7	8.9	11.4
Percentage distribution of foreign-born population, 1950, by country of birth:					
All countries	100.0	100.0	100.0	100.0	100.0
England, Wales, Scotland	7.2	2.8	7.0	6.3	5.4
Ireland	7.6	7.0	6.2	7.1	5.8
Germany, Austria	16.0	7.9	14.1	21.9	15.0
Poland, Czechoslovakia, Hungary, Yugoslavia, Lithuania, Rumania	28.8	25.3	26.9	33.1	41.0
Union of Soviet Socialist Republics	10.6	13.0	32.4	2.8	6.8
Italy	20.7	30.6	4.2	12.4	20.3
All other countries	9.1	13.4	9.3	16.4	5.6

area 1 in economic status, areas 15 and 16 differ from it with respect to ethnic and color groups and the proportion of individuals of foreign birth. For example, area 15 has practically no nonwhite persons and approximately half as many foreign-born individuals as does area 1. Also, among its foreign-born population, there are considerably fewer Italians and Russians. These and other demographic characteristics of the four areas are given in table 4.

Area 1—High Prevalence

The age-standardized rates for area 1 show that both the white men and the white women of the downtown and hill sections experi-

Table 5. Observed and expected [1] frequencies of cancer cases among the white male population of area 1, Pittsburgh, 1947

Primary site	Age group										Total cases	
	7–16 years		27–46 years		47–56 years		57–66 years		67 years and over			
	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected	Observed [2]	Expected
All sites	3	1.48	16	9.40	26	17.05	46	38.73	57	41.61	153	108.0
Buccal cavity and pharynx	1	.12	3	.80	2	.93	2	2.05	4	2.46	12	6.4
Digestive	------	0	2	2.12	10	5.43	9	13.54	19	14.43	40	35.5
Respiratory	------	.06	2	1.03	3	3.00	12	6.32	7	3.38	24	13.8
Breast	------	0	------	0	------	.07	------	0	------	.15	1	.2
Genital organs	------	.12	------	.69	2	1.13	4	3.94	12	7.52	18	13.4
Urinary organs	------	.06	1	.63	------	1.19	1	3.69	1	2.69	3	8.3
Skin	------	.12	5	1.43	4	2.65	6	4.76	10	6.37	29	15.3
Other sites	2	1.00	3	2.69	5	2.65	12	4.43	4	4.61	26	15.4

[1] Expected frequencies calculated on the basis of city's age-sex specific rates.
[2] Observed frequencies total includes 5 of unknown age.

enced higher prevalence of cancer than did white men and women outside the area. The rate for the white men of the area was 43 percent higher than the rate for white men in the remaining portion of the city; that for the women, 28 percent higher; and in both instances, the level of significance was less than .001.

Of particular interest is the fact that the white men of area 1 experienced unusually high rates for cancer of the skin and of the respiratory system. In each case, the rate was practically twice that for men living elsewhere in the city, and the probability that the difference was due entirely to sample variation was less than .001. There were also indications that the rates were high for white men of the area for cancer of the buccal cavity, pharynx, and among "other sites," which includes cancer of the brain, central nervous system, endocrine glands, bone, eye, soft tissues, and the leukemias and lymphomas (table 5). Among the white women, the rate for cancer of the genital organs was high—60 percent above the city average.

With the somewhat startlingly high prevalence rates in area 1, one wondered how mortality among its reported cases compared with deaths among all reported cases. By the end of the study year, 59 of the 153 white men in area 1 with reported cases of cancer had died. Had the city rate prevailed, only 37 deaths would have occurred. Also, throughout all the age groups, the mortality rate was higher than that for the rest of the city, and the overall result was that the area led all others. High mortality rates were observed for all but two of the primary site groups. One of these groups was that of the urinary organs, a group for which lower prevalence rates were also observed. The other group was cancer of the skin. The women of area 1 fared somewhat better than the men so far as mortality during 1947 was concerned. Even then, their rates were next to the highest, which were observed in area 2.

Since the nonwhite population of area 1 makes up more than half of the area's population and 55 percent of the entire nonwhite population in the city, it seemed pertinent to ask: How did the nonwhite population of area 1 compare with the remaining nonwhite population? and how did the nonwhite population compare with the white population, within and outside area 1?

Practically no differences existed between the nonwhite men of the area and those outside. In fact, what little difference there was tended to be in favor of the nonwhite male within the district. The same cannot be said, however, for the nonwhite females who experienced higher rates than did the nonwhite females outside the section, at all ages and for all primary sites. The comparisons for the two nonwhite popula-

Table 6. Cancer prevalence age-specific rates per 100,000 population among nonwhite males and females in area 1 compared with the rest of Pittsburgh, 1947

Age group (years)	Nonwhite males		Nonwhite females	
	Area 1	Remainder	Area 1	Remainder
	Number of cases			
7–26	2	--------	4	--------
27–46	5	3	36	16
47–56	19	12	33	20
57–66	11	13	19	15
67 and over	9	10	22	15
	Rate			
7–26	35	0	63	0
27–46	79	63	502	304
47–56	595	548	1,374	994
57–66	713	1,081	1,586	1,304
67 and over	1,083	1,274	3,043	1,911

Table 7. Expected cancer cases when nonwhite age-specific rates for area 1 and rest of city are applied to the corresponding nonwhite populations of Pittsburgh, 1947

Primary site	Nonwhite males		Nonwhite females	
	Area 1	Remainder	Area 1	Remainder
All sites	81.7	86.8	213.8	141.1
Buccal cavity and pharynx	5.6	4.6	11.1	6.1
Digestive	30.5	19.6	32.2	20.7
Respiratory	15.5	12.0	2.0	2.0
Breast	0	0	38.5	33.8
Genital organs	7.2	22.1	100.8	60.9
Urinary organs	3.4	7.2	3.8	2.4
Skin	0	9.1	3.7	3.8
Other sites	19.6	12.2	21.8	11.3

tions are shown in tables 6 and 7. Table 6 gives age-sex specific rates. Table 7 contains the expected frequencies which are obtained when the age-specific rates for the nonwhite population of area 1 and the corresponding rates for the remainder of the city are applied to the total nonwhite population of the city.

As in other cities, the reported prevalence rates for the white population exceeded those for the nonwhite population. This was especially true of the rates for males. White males in Pittsburgh experienced a rate which was 86 percent higher than the one for nonwhite males. With cancer of the skin excluded, the rate for the white males was still 66 percent higher. In area 1, though, the differences between the two racial groups were even more pronounced. There the age-adjusted rate for white males with skin cancer included exceeded that for the nonwhite males by 173 percent and by 138 percent with skin cancer excluded.

Area 2—High Prevalence

Area 2, with a high socioeconomic status, with very few of its men employed as craftsmen, operatives, or laborers, and with a large proportion of Russian-born individuals, experienced the highest cancer prevalence rate for white women and the second highest for white men. By age, this area led in rates for women aged 27 through 66 and for men aged 67 and over. Women of the area also experienced the highest mortality rate for cancer.

The most noticeable difference between this section and the other areas was its unusually high prevalence rate for breast cancer. With age distributions taken into account, breast cancer was reported twice as frequently among white women of area 2 as among white women in other parts of the city. The probability that this difference was due to sample variation alone was less than .001. By separate age groups, the breast cancer rates in the area surpassed all other areas in every age group except 47–56, for which area 5 had a higher rate. Among the women, high prevalence rates were also observed when the primary site of cancer was the digestive organs or the peritoneum.

It has been suggested that these high rates, especially those for breast cancer, may be the result of more comprehensive medical care asso-

Table 8. Observed and expected [1] frequencies of cancer cases among the white female population of area 2, Pittsburgh, 1947

Primary site	Age group					
	7–26 years	27–46 years	47–56 years	57–66 years	67 years and over	Total cases [2]
All sites:						
Observed	4	57	60	71	57	258
Expected	2. 88	33. 11	43. 65	50. 95	50. 86	181
Digestive organs:						
Observed	1	9	11	17	16	54
Expected	. 23	2. 89	9. 09	12. 16	16. 36	41
Breast:						
Observed	----------	29	20	29	21	102
Expected	. 08	11. 35	12. 89	13. 77	12. 10	50
Genital organs:						
Observed	----------	6	14	13	4	41
Expected	. 53	8. 95	12. 36	12. 96	7. 63	42
Other sites:						
Observed	3	13	15	12	16	61
Expected	2. 04	9. 92	9. 31	12. 06	14. 77	48
Ratio, observed to expected:						
All sites	1. 4	1. 7	1. 4	1. 4	1. 1	1. 4
Digestive organs	4. 3	3. 1	1. 2	1. 4	1. 0	1. 3
Breast	0	2. 6	1. 6	2. 1	1. 7	2. 0
Genital organs	0	. 7	1. 1	1. 0	. 5	1. 0
Other sites	1. 5	1. 3	1. 6	1. 0	1. 1	1. 3

[1] Expected frequencies calculated on the basis of city's age-sex specific rates.
[2] Observed frequencies total includes 9 of unknown age.

ciated with high socioeconomic status. There are some indications that this may be partially true, but at the same time, there are two reasons why such an explanation can hardly account for the entire excess. The first is that mortality data lend support to the morbidity evidence. For example, in 1947, mortality among women with breast cancer was highest in area 2. An idea of the high mortality is given by applying the area's age-specific mortality rates to the city's population. Had the area's rates prevailed throughout the city, one would have seen 221 deaths among white women with breast cancer instead of the actual number of 113. No other area gave an expected number as high as 221.

The second reason for doubting that extensive medical care explains entirely the high rates is that the differential does not appear, or if it does, not to the same degree, for other sites. This is demonstrated in table 8.

Areas 15 and 16—Low Prevalence

The lowest prevalence rates for cancer were reported for two adjacent areas on the north side of Pittsburgh, both areas of low socioeconomic status. With sample size taken into account, both areas showed low rates for white males and females. Also, one or both areas had low prevalence rates for the age groups 27–46 and 67 and older, among the men; and 47–56, 57–66, and 67 and older, among the women. The women experienced markedly low rates for cancer of the digestive organs, breast, and the genital organs.

In areas 15 and 16, mortality data did not correspond completely with the morbidity findings. Therefore, these areas of low prevalence are perhaps less sharply defined than the areas of high prevalence. The greatest dissimilarity between morbidity and mortality occurred among white men of area 15, the prevalence rate being the third lowest and the mortality rate the second highest. In area 16, however, mortality among men, as well as prevalence, was at its lowest. In both areas, mortality among women was similar to that of all women in the city.

Cancer of the Digestive Organs

Bigelow and Lombard (*3*), in their study of cancer mortality in Massachusetts, have referred to lower mortality from cancer of the stomach and the lower intestinal tract among Italian-born males in comparison to all foreign-born males. In view of this, some findings concerning area 8, which is predominantly Italian, may be of interest. Among the foreign-born population of area 8, two-thirds are of Italian birth. In 1947, among white males of the 16 areas, the lowest prevalence and mortality rates for cancer of the digestive organs were observed in area 8. If the age-specific prevalence rate of this area is applied to the city's population, we would expect 259 cases. This is much lower than the 472 cases actually reported for the city. Similar applications of age-specific mortality rates gave an expected number of 130 deaths for the city when the rates of area 8 were used, while the number of deaths occurring in the city among white men with cancer of the digestive organs totaled 253.

Summary and Discussion

It has been pointed out that during 1947, there were two distinct areas of Pittsburgh in which, if we take into account age distributions, the white population experienced high prevalence of cancer. These districts were first the "downtown" and "hill" region (area 1) and next the section usually referred to as Squirrel Hill (area 2).

Area 1, with the lowest economic status, the highest proportion of nonwhite population, and the greatest number of foreign-born individuals, led all areas in cancer prevalence and mortality among white males. Also, both the white and nonwhite females of the area experienced high prevalence and mortality. The nonwhite males, however, fared better than those who resided outside the area.

Among the white males of the downtown and hill districts, prevalence rates were especially high for cancer of the skin and of the respiratory system. Furthermore, their rates for cancer of the buccal cavity and pharynx and of a residual group termed "other sites" were relatively high. This same group of men, however, experienced more favorable rates for

cancer of the urinary organs than did all white men, and their rates for cancer of the genital organs and digestive organs were near the city average. Mortality data supported all prevalence data except, of course, those for cancer of the skin.

Second highest prevalence rates for the white population were observed in the Squirrel Hill area which, in contrast to area 1, is of high social and economic status. This area (area 2) led all others in cancer prevalence and mortality among white women and followed only area 1 in prevalence among white men. When women were considered separately, breast cancer was the principal reason for the area's top ranking. Women of the area also experienced high rates for cancer of the digestive organs.

The two areas with lowest prevalence rates included portions of the central and eastern parts of the "north side" (area 15) and Woods Run and Manchester (area 16). Both of these areas are of low economic status. In this respect, they resemble area 1, even though they have fewer nonwhite and foreign-born people.

One predominately Italian section (area 8) of Pittsburgh has been mentioned because its white men experienced the lowest rates for cancer of the digestive organs, both in prevalence and mortality. With all sites taken into consideration, the prevalence rate for these men was 16 percent lower than the city average, and only 5 areas had lower rates.

These findings in area 8 suggest that the presence of a rather large group of Italians of foreign birth in the downtown and hill districts was not a major factor in its high prevalence of cancer among white men. Also, in view of the excessive rates in the high socioeconomic area 2 and the favorable rates in the low socioeconomic areas 15 and 16, high rates in area 1 cannot be attributed to the mere fact that this section is of low socioeconomic status.

The high rates for cancer of the skin and the respiratory system among the white men of area 1 might suggest to some the possibility of air pollution as the major, or at least a contributory, cause. Such a hypothesis has been proposed by Stocks in his observation of an area of London with high mortality from cancer of the respiratory system (*4*). Surely, in the case of area 1 in Pittsburgh, one doubts that the atmospheric environment of this geographic section was a major cause of skin and respiratory cancer among the white men. To believe that it was, one would have to assume that it affected only the white men and not the white women or the nonwhite men and women residing in the area. The white women experienced no more cancer of the skin or respiratory system than did the white women in other parts of the city. Furthermore, respiratory cancer among the nonwhite people of the area was no higher than that observed among nonwhite individuals living elsewhere. Also, what evidence there is regarding air pollution in Pittsburgh does not suggest that the atmospheric environment of area 1 might be less favorable than that of other areas. During 1912–13, 1923–24, and 1929–30, the Mellon Institute of Industrial Research determined the amount of solids precipitated in the different sections of Pittsburgh. Meller reports that during none of these periods were the downtown and hill districts considered the dirtiest. In fact, this dubious honor was bestowed each time upon Woods Run, a part of area 16 (*5*). More recently, Ely has stated that specific atmospheric contaminants are quite uniformly distributed throughout the various sections of the city (*6*).

Another question which may be raised is: Does the comprehensive medical care usually associated with higher socioeconomic groups tend to "increase" the prevalence among these groups? In partial answer to this question, one can consider the "class of case" reported and the number of persons surviving through the study year.

Cases of cancer were of 3 categories: (*a*) first diagnosed in 1947, (*b*) diagnosed prior to 1947, but treated in 1947, (*c*) diagnosed and treated prior to 1947 and "only observed" in 1947. Among the cases reported for white men, only 9.3 percent were of the third category, and there was little variation in this proportion from one geographic area to another. Among the white women, however, 19.9 percent of the reported cases were of the third category, and the range among the areas was from 3.1 percent (area 16) to 33.6 percent (area 2). Also, the 6 areas with the highest proportion of cases in the third category showed the highest prevalence rates

Table 9. The relationship of cancer prevalence (measured in terms of expected cases), percentage of cases diagnosed and treated prior to 1947 and "only observed" in 1947, and percentage of cases surviving through 1947—white females, Pittsburgh

Area	Number of expected cases [1]	Percentage of cases "only observed"	Percentage of cases surviving through year
2	2,494	33.6	74.8
3	2,335	26.2	68.9
1	2,293	23.7	70.2
4	2,145	24.2	71.7
5	1,941	28.6	70.0
8	1,787	27.8	71.4

[1] Obtained by applying area's age-specific rates to the city's population.

and the lowest mortality among reported cases.

Table 9 suggests that among white females the prevalence rates, as well as the number of persons surviving through the year, may have been related to the number of cases which were diagnosed and treated prior to the study year and only observed during the study year. Surprisingly, the possible relationship was not limited to the higher socioeconomic groups since 3 of the 6 areas, area 1, area 3, and area 4, are of low socioeconomic status. Moreover, area 8 is of average socioeconomic status, and only areas 2 and 5 are of high socioeconomic status.

The possible effect of "only observed" cases on a prevalence rate does not invalidate the findings which showed high prevalence of cancer of the breast and digestive organs among white females in area 2, since these were supported by mortality data. Nevertheless, prevalence data covering a relatively short period (1 year) may be misleading when one considers subgroups of an urban population. Undoubtedly, the prevalence rates of different areas may be affected by such factors as early diagnosis versus late diagnosis, variation in survival rates, and the overreporting that might result from continued supervision after treatment. And in the extreme case, an area showing the lowest prevalence rate for a year may be experiencing consistently the highest mortality rates. In view of this and similar possibilities, information concerning cases at time of diagnosis (incidence) over a period of several years might be of greater value in delineating small areas than are prevalence data for a year.

Finally, the reason why one may wish to establish small areas which experience a great deal or relatively little cancer might be mentioned. Certainly, the delineation of such areas does not reveal the cause of their low or high rates. But it does provide the epidemiologist with geographic sections in which etiological investigations may prove worth while.

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Shellfish producers and regulatory agencies in the United States and Canada have a common interest in this study which shows a high increase in bacteria count during the shucking operation—suggesting that the shucking stage is the most likely source for contamination of oysters during processing and marketing.

Bacteriological Control of Oysters During Processing and Marketing

By C. B. KELLY
WILLIAM ARCISZ, B.S.

INTELLIGENT GUIDANCE of the oyster industry by regulatory officials has been hampered for some time by a lack of fundamental knowledge of the changes in bacterial content of oysters as they proceed through shucking, packing, and transportation to the market. Without this background of information, it has been difficult to evaluate the regulatory program and to make reasonable interpretation of bacteriological results obtained at the market level. The importance of the problem has recently been manifested by reports of high bacteriological results obtained on shipments made to certain consuming centers. These difficulties have been recognized by Federal and State regulatory agencies, and, as a result, the Robert A. Taft Sanitary Engineering Center of the Public Health Service was requested to undertake a study to determine some of the factors involved. The study was conducted by the center's Shellfish Sanitation Laboratory, when it was located at Woods Hole, Mass.

Mr. Kelly, since 1949 chief of the Shellfish Sanitation Laboratory of the Robert A. Taft Sanitary Engineering Center of the Public Health Service, was formerly sanitary chemist with the bureau of marine fisheries, New York State Conservation Department. Mr. Arcisz, formerly with the United States Fish and Wildlife Service, is bacteriologist with the laboratory. The laboratory has been moved to Pensacola, Fla., from Woods Hole, Mass., where the study reported herein was directed.

The results of this study are also being published in the Proceedings of the Joint Meeting of the Oyster Institute with the National Shellfisheries Association.

The Sampling Program

It was considered of first importance to determine the bacterial changes that should normally be expected in oysters during harvesting, shucking, washing, packing, and transportation to the market. To determine this, it was quite evident that there should be designed a carefully controlled program of sampling in representative shucking houses and related establishments, tracing as nearly as possible a single lot of oysters from the time of delivery as shell stock to the shucking house to receipt of the product in the wholesale market. The eastern oyster, *Crassostrea virginica*, was the species studied throughout this project.

The program required the cooperative efforts of interested agencies in the producing and receiving States involved and of interested agencies of the Canadian Department of National Health and Welfare for the actual work of in-

spection, sampling, and laboratory examination. It was considered that adequate data could be obtained if an inspection and a sampling of each plant were conducted at least once a month.

The following four sampling stations were established at each plant for tracing a single lot of oysters:

1. "Shell oysters"—A composite sample was taken of shell stock on shuckers' benches.

2. "As shucked"—A composite sample was taken of shucked oysters as they were shucked. For this sample, each shucker shucked 1 oyster directly into a sterile 1-pint mason jar. Random sampling was conducted in the larger plants where 1 oyster collected from each shucker would provide more than 1 pint of sample.

3. "First skimmer"—A composite sample of shucked oysters was collected from at least 5 shuckers' pots as the oysters were delivered to the packing room and after preliminary washing on the first skimmer.

4. "As packed"—A sample was collected from a commercial can immediately after packing. The sample represented the lots previously taken as samples at the three preceding sampling stations. If the pack was intended for the market, two 1-pint cans or one ½-gallon can were also taken for shipment to the Shellfish Sanitation Laboratory at Woods Hole, Mass. If the lot was intended for repacking, the container was marked for identification when it reached the repacking house.

Arrangements were made for the interception of commercial shipments at marketing centers. Notification was made by telegram to the control agencies in the marketing city, giving destination, expected time of arrival, and approximate size of shipment.

To assure that an examination of the packed oysters would be conducted at the market level, a pilot shipment of each such lot was made to the Shellfish Sanitation Laboratory at Woods Hole. Two 1-pint cans or one ½-gallon can of the lot being shipped to market on that day were shipped, refrigerated in ice, by railway express to Woods Hole. The time in transit of both shipments was approximately the same. The oysters, on arrival, usually had sufficient ice to maintain the temperature of the samples below 50° F. There was no way to determine whether the samples had been refrigerated continuously at this temperature since on some occasions re-icing was necessary in transit.

Methods of Examination

As nearly as possible, bacteriological procedures were similar in all participating laboratories. They were conducted according to an outline submitted to the laboratories before the beginning of the study. The outline described the procedure somewhat more in detail than is contained in the procedure recommended by the American Public Health Association for the bacteriological examination of shellfish and shellfish waters (*1*).

Results

During the 1950–51 and 1951–52 seasons, some 45 inspections and samplings were made in the shucking houses selected. Of these, 42 samplings were followed through pilot shipment to Woods Hole. The 3 series not included were incomplete.

Results of bacteriological examinations are shown in the accompanying table and in figures 1 and 2. The results were grouped according to the following classifications:

	Coliform MPN's per 100 ml.	*Standard plate count per ml.*
Group 1	Less than 230	1–1,500.
Group 2	230–2,400	1,600–10,000.
Group 3	2,401–24,000	11,000–50,000.
Group 4	24,001–less than 160,000.	51,000–less than 1,000,000.
Group 5	160,000 or more	1,000,000 or more.

These values are not intended to be suggested as control standards. Some of the values, however, are limits suggested by the Public Health Service and the Canadian Department of Health and Welfare, on an interim basis, for use in evaluating the bacteriological quality of shellfish as taken from the growing area or as sampled in the processing plant or in the market. Source materials for some of these values are listed below:

1. The United States Public Health Service

Coliform MPN's and standard plate counts of oysters sampled during processing and marketing

Values	Shell		As shucked		First skimmer		As packed		Woods Hole		Market	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
	Coliform MPN											
Less than 230	27	60	0	0	3	7	6	15	4	10	0	0
230–2,400	10	22	12	28	19	44	17	40	14	33	16	46
2,401–24,000	8	18	25	58	17	40	19	45	9	21	10	28. 5
24,001–<160,000	0	0	5	12	3	7	0	0	6	14	6	17
160,000 or more	0	0	1	2	1	2	0	0	9	21	3	8. 5
Number of samples	45	------	43	------	43	------	42	------	42	------	35	------
	Standard plate count											
1–1,500	22	50	5	12	3	7	6	14	18	43	4	11
1,600–10,000	14	32	21	50	24	56	26	60	8	19	19	54
11,000–50,000	7	16	16	38	16	37	9	21	7	16. 5	5	14
51,000–<1,000,000	1	2	0	0	0	0	2	5	7	16. 5	7	20
1,000,000 or more	0	0	0	0	0	0	0	0	2	5	0	0
Number of samples	44	------	42	------	43	------	43	------	42	------	35	------

in the Manual of Recommended Practice for Sanitary Control of the Shellfish Industry (*2*) suggests a limiting coliform MPN (most probable number) of 230 per 100 ml. in oyster shell stock sampled at the growing area or in shell stock or shucked oysters at the point of shucking. Coliform MPN's of that value or greater should be interpreted as indicative of unfavorable conditions or practices surrounding the production and handling of the product. The manual also suggests that, in occasional samples, a coliform MPN value of 2,400 may be tolerated.

2. The Interdepartmental Shellfish Committee of Canada, at a meeting in Ottawa in March 1950, suggested the following classifications of results for shucked oysters from the United States, as received in the Canadian market. Since that time, these limits have actually been applied on an interim basis in reviewing shipments from the United States.

Class 1. Acceptable. Shellfish with most probable numbers (MPN) of coliform bacteria of not more than 2,400 per 100 ml. and/or a standard plate count of not more than 50,000 per ml.

Class 2. Acceptable on Condition. Shellfish with a coliform MPN of less than 160,000 per 100 ml. and/or a standard plate count of less than 1,000,000 per ml.

(The United States Public Health Service is notified of the receipt of these shipments falling in class 2. The oysters are accepted on the condition that the State authority concerned will conduct immediate investigations of the producer's plant and operations, and a report of such investigations will be submitted by the Public Health Service to the Canadian Department of National Health and Welfare. On the basis of this report, Canada will reject or permit

Figure 1. Classification of coliform MPN results.

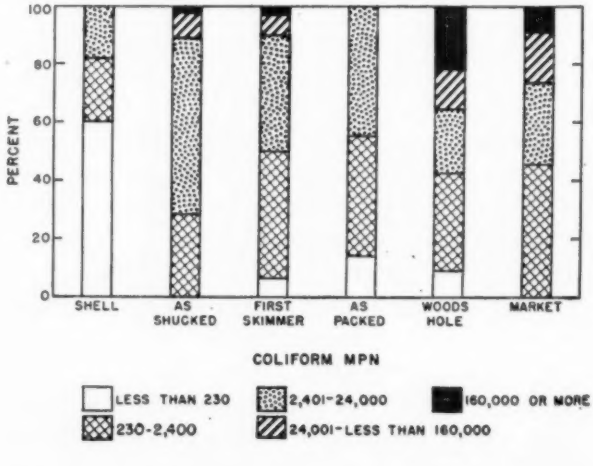
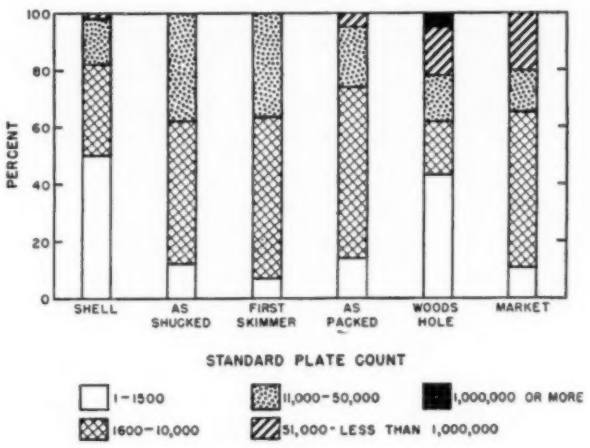


Figure 2. Classification of standard plate counts.



further shipments from the producer in question.)

Class 3. Rejectable. Shellfish with a coliform MPN of 160,000 or more per 100 ml. and/or a standard plate count of 1,000,000 or more per ml.

A classification of the coliform results obtained is given in figure 1. Of particular significance is the difference between the shell stock and samples as shucked. In comparing the results obtained at these sampling points, it must be borne in mind that in the laboratory examination of shell stock the exterior surfaces of the shell are thoroughly scrubbed under running water to remove adhering mud and detritus. Of the shell stock samples, 60 percent (27 of 45 samples) showed coliform MPN's less than 230, and no samples showed coliform MPN's in excess of 24,000. Comparing these results with the product as shucked, none of the samples of oysters as shucked showed coliform MPN's of less than 230, and approximately 75 percent (31 of 43 samples) of the samples showed coliform MPN's in excess of 2,400. A significant number—approximately 15 percent (6 of 43 samples)—showed coliform MPN's in excess of 24,000.

Suggestions concerning the cause of the higher bacterial content after shucking can be gathered from a supplementary investigation in which an additional sampling station was interposed. To eliminate the possibility of contamination from the shucking equipment, samples were collected from a shucker who had previously sanitized his equipment and had thoroughly scrubbed his hands. A series of 18 such samplings was conducted. Comparison of results obtained on samples from this series with those obtained on the same lots regularly commercially shucked showed little difference in either coliform MPN or standard plate count. There then remains only the factor of the bacterial content of the mud and detritus on the exterior surfaces of the shells and the possibility of incorporation of this material with the oyster meats during the shucking operation.

Some reduction in coliforms was accomplished in the remaining stages of processing. The number of "as packed" samples showing coliform MPN's of 2,400 or less increased from 28 to approximately 50 percent (23 of 42 samples) of the total number of samples examined. There were no samples showing coliform MPN's in excess of 24,000.

The results obtained on the Woods Hole samples show some increase in coliform bacteria. The greatest difference between the product as packed in the shucking house and as received at Woods Hole is in the number of samples showing coliform MPN's in excess of 24,000. About 35 percent (15 of 42 samples) of the samples were in this group although there was no significant change in the percentage showing coliform MPN's of 2,400 or less.

For comparative purposes, there is included in figure 1 an analysis of results of examinations made by the Canadian Department of National Health and Welfare on shipments to Montreal (see "Market," fig. 1) from the same producing State, collected during the same period, but not necessarily of the same lots. Approximately the same number of samples (35) were examined. The similarity to the Woods Hole samples is quite close. It will be seen that an almost equal percentage (43 and 46 percent) showed coliform MPN's of 2,400 or less. No "market" samples showed coliform MPN's of less than 230, while a significant number—approximately 10 percent (4 of 42 samples)—of the Woods Hole samples were in that category.

Results of agar plate counts (tryptone glucose extract agar, 48 hours, 37° C.) are classified in figure 2.

The standard plate count has been mentioned (*1*) as a useful index of general sanitation and refrigeration. Determinations of standard plate count were made on all samples examined bacteriologically. The results indicate, generally, little difference between the standard plate count and coliform MPN. The increase in number of bacteria, as indicated by the standard plate count, between the "shell" and "as shucked" samples, is practically of the same order as the increase in coliform bacteria. The same degree of recovery in the product as packed will be noted, as well as the increase during transportation to Woods Hole or to the market.

Conclusions and Recommendations

The bacteriological results obtained reveal that the increase in bacterial content of oysters during processing occurred in the shucking operation. Examination of the shell stock showed that the meats were usually of good bacteriological quality. However, the same oysters shucked in commercial practice showed a significant increase in bacteria—both the coliform MPN and the standard plate counts were higher.

The exact cause of the increase in bacteria cannot be attributed entirely to contamination as a result of sanitary deficiencies in the shucking room. Oysters shucked under controlled commercial conditions known to be clean showed little difference in bacteriological results from those shucked under regular commercial practice. The more serious source of contamination is therefore apparently the mud and detritus adhering to the exterior of the shells.

Since incorporation of such material during the shucking operation is unavoidable if the oysters are muddy, contamination from this source would be eliminated only by thorough washing of the shell stock at the time of harvesting and before transfer to the shucking bins.

In the plants under investigation, there generally was observed a reduction in bacteria as the oysters proceeded through the processes of washing and packing although return to the level of the shell stock was not accomplished.

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PHS Staff Announcement

Dr. Henry van Zile Hyde, chief, Division of International Health, Public Health Service, was elected chairman by the Executive Board of the World Health Organization on May 27, 1954. Dr. Hyde was first appointed by the President as the United States member of the board in 1948 and reappointed in 1953. During the war, he served in the Middle East with the Foreign Economic Administration and later as chief of the Middle East office of the United Nations Relief and Rehabilitation Administration. He has also served as chief of health and sanitation for the Institute of Inter-American Affairs and for the Technical Cooperation Administration.

Symposium on Air Pollution

STATEN ISLAND, situated in the heart of the air pollution area of urban New York and New Jersey, was the site of the second annual symposium on air pollution control held March 1954.

The symposiums are sponsored by the department of bacteriology and public health of Wagner College, Staten Island, N. Y., in cooperation with the borough president's Committee for Air Pollution Abatement.

Symposium papers on the engineering aspects of air pollution control, toxicological research, the State control program established by New Jersey, and the industrial control equipment, particularly installations of utility companies, are presented in brief below.

In prefatory remarks, Natale Colosi, Ph.D., professor and chairman of the Wagner College department of bacteriology and public health, and chairman of the Committee for Air Pollution Abatement, summarized the air pollution problem confronting Staten Island and vicinity. Dr. Colosi referred particularly to the report of a preliminary study conducted by the Richmond County (N. Y.) Medical Society and the committee. The findings, he stated, indicate that air pollutants are having adverse effects on the health of Staten Island residents. He also reported the committee's observations on the damages to plant life ascribed to air pollution and confirmed by agricultural experts. Dr. Colosi said the consensus of the committee is that air pollution in the area is an interstate problem and should, therefore, be controlled by an interstate agency.

Interstate Study Proposed

The efforts New York and New Jersey officials have made to initiate an interstate study of air pollution were described by two New York State Department of Health officials, Earl Devendorf, P.E., director, and A. Rihm, Jr., P.E., senior sanitary engineer of the bureau of environmental sanitation. Solution of an interstate problem, such as air pollution, is complicated both legally and administratively, they pointed out.

In 1949, it was decided that a survey should include an epidemiological study of the ill effects people reported; location of the plants causing contamination and determination of the materials being emitted by the stack; and collection and correlation of meteorological data to determine the need for an air sampling program. The complicating factor was the lack of sufficient State and city funds to employ the 10 public health nurses, 8 engineers, and 6 to 8 chemists, and to purchase the equipment, supplies, and laboratory and office space needed in carrying out the proposed study.

Subsequently, the officials reported, the Interstate Sanitation Commission, set up by the legislatures of New York, New Jersey, and Connecticut to deal with water pollution affecting the metropolitan New York areas, agreed to make the survey if its functions were enlarged to include jurisdiction over air pollution and adequate funds were appropriated. The commission has estimated that $60,000 will be needed. Enabling bills have been introduced this year in the New York and New Jersey legislatures, the officials reported.

Catalytic Process

The function of catalysts in fume combustion as an air pollution control measure for some types of manufacturing processes was discussed by Paul H. Goodell, sales manager of the Catalytic Combustion Corporation, Detroit. A catalyst is a substance which accelerates a reaction

without itself entering into the end products. In fume combustion, the catalyst assists in the oxidation of hydrocarbons and organic gases, thus converting the noxious fumes into carbon dioxide and water vapor. The oxidation also results in energy recovery.

Catalytic oxidation is broadly applicable to hydrocarbon and organic type fumes, including alcohols, esters, ketones, ethers, acrolein, aldehydes, hydrogen, carbon monoxide, and mercaptans, Goodell reported. The process, he said, is considered unsuitable when the fumes contain large amounts of cinders, inorganic solids, or vaporized metals that would cause rapid deterioration of the catalyst—such as the gases from foundry cupolas, blast furnaces, or coal-fired boilers. Normal atmospheric dust, he said, causes no difficulty and, in some cases, low concentrations of process inorganics can be tolerated.

The largest single catalytic fume combustion installation, now under construction, will have a 160-square-foot catalyst bed to handle approximately 80,000 cubic feet per minute of furnace exhaust gases, Goodell reported.

An Engineering Job

PHR brief

In the last decade the public has awakened to the idea that the air has some form of boundary and that it is possible to overload the air of a city with waste substances, just as streams and harbors were overloaded years before.

But the discovery of the offending air pollutants in a particular locality and their source must await engineering investigation and analysis if we are to avoid prejudging industry without adequate evidence.

The drudgery and leg work necessary while accumulating information are considerable. The time required to establish the facts is measured in months or even years. The costs in manpower, equipment, and laboratory work are high.

It is much easier to guess at characteristics than to evaluate them. An old story, one that can be damaging to sincere engineering effort, is repeated when well-meaning but sometimes poorly informed persons accuse industry of being defilers of pure air almost to the exclusion of other less recognizable sources of air pollution.

A technical survey of the industries and fuel burning equipment in New Haven, Conn., revealed, for instance, that no more than 20 to 35 percent of the dustfall was from tall industrial chimneys. The primary problem could have been in blackness rather than total quantity of dustfall. The burning of No. 6 fuel oil contributed a high proportion of carbon.

In the Los Angeles area millions of dollars have been spent and years have passed since the initial investigations. Much information has been obtained and many aspects of the problem of control have been dealt with, but some evaluation is still to be made. The addition of unburned hydrocarbons from automobile exhausts and tonnage of organics contributed from burning refuse loom as significant factors in the air pollution picture. Although the effects of petroleum industry operation are not to be minimized, it is now apparent that those who accused that industry years ago without benefit of engineering data were only partly right.

By William T. Ingram, associate professor of public health engineering, New York University College of Engineering.

Industrial Surveys

The actual content of an industrial survey will depend on the variety of industry and type of process, on the source of fuel for combustion apparatus, on the design features of equipment, and on the quality of operation of any and all installations.

Manufacturing establishments in an area may be classified by principal products. For example, the following classification of industry has been used in Louisville.

Ceramic products	Public service corporation
Chemical products	Textile products
Distilleries	Tobacco
Food products	Miscellaneous plants
Printing and publishing	

The industrial survey should have some or all of the following information and perhaps more for special conditions.

1. Maps should show the process layout and location of principal sources of emission together with pertinent dimensions for estimating discharge flow rates and volumes. Process flow diagrams should be detailed enough to show both normal and emergency points of discharge and conditions under which they operate.

2. Flow charts should be constructed to indicate the raw materials and their points of addition; the losses from process as waste, with sufficient information to determine the character of waste and the quantity that is lost; the method of treatment of each loss and the means of disposal; the finished products; and the operating schedule.

3. Maintenance of process and treatment should be indicated in order to show the circumstances under which unusual emissions may occur when repairs are being made or equipment is out of service.

4. Fuels and fuel-burning equipment should be itemized so that quantitative data are available on fuel analyses, boiler ratings, dust and ash produced, stack temperatures, and gas volumes maintained.

5. Specific information on all air cleaning equipment should be listed to show the kind of cleaner, its rating, efficiency of cleaning, and periods of bypass, or nonoperation.

A catalog of industrial air cleaning equipment would include devices that remove particles of all sizes from wood splinters to aerosols, neutralize acids and alkalies, adsorb gases, and convert vapors. The air cleaning equipment required will depend on the industrial process.

Not all atmospheric pollutants are exhausted through a smoke stack. Some are expelled from ducts at or near ground level. Some find their way to the outer air from the ports of natural ventilation such as windows, louvres, and roof vents. Control of all such outlets may be indicated under certain conditions. Air cleaning devices suitable for cold processes may be unusable on hot processes. Devices suitable for noncorrosive substances are probably not satisfactory if strong acids or alkalies are formed. Those suitable for low velocity and small volume may be inadequate if the process gas flow is high velocity or high volume.

Installations suitable for constant input operations may be inefficient if the input quantity or quality is variable.

The engineer must observe and record the facts about processes and process operations that will allow him to design workable air cleaning devices. When an industry is faced with the necessity of meeting standards of particle content, smoke density, chemical concentration, and other standards included in legal controls, the importance of competent selection becomes clear.

The engineer who is responsible for equipment selection in the first place should not be employed by the agency that checks the operation of a device for conformance with legal standards. In blunt language, the municipal air pollution control engineer should never be put in the position of passing on his own design. If industrial staff cannot do the required design, consultants should be employed for the work.

Choice of Control Method

Economics of corrective measures are part of the engineering. It costs approximately $600,000 to control emissions of a 50-ton capacity open hearth furnace. Precipitator installations at large powerplants have amounted to $1 million per boiler unit. Incinerators cost from $2,000 to $4,000 per ton of rated daily capacity. A rubber plant on the west coast has spent $150,000 on the development phase of pollution control equipment. The equipment requires water that is not yet available and a sewer that has to be built before any installation can be made.

It should be quickly recognized by both industry and municipal agency engineer that the removal of noxious materials before they reach the outside air is an effective step in air pollution control, but one that requires the exercise of competence and judgment in its accomplishment. Atmosphere can serve effectively as a diluent, and the degree of efficiency to which process air cleaning is geared must be determined so that neither the industry nor the public is penalized unduly. We have not yet reached that Utopian stage of standardized air

cleaning in which filters, cyclones, washers, bag units, or precipitators can be ordered out of stock. Each control unit is practically custom made for particular needs.

The public should not become overly impatient because it takes time to complete an air cleaning installation, but it has every right to insist on competent engineering and progress on any installation in order to obtain the anticipated degree of pollution protection in the completed unit.

Toxicological Studies

PHR brief

As with any problem in toxicology, the effects of air pollution may be divided into the acute and the chronic.

Although in one instance chronic beryllium poisoning was reported among persons living near a beryllium manufacturing plant, the evidence is not sufficient to permit conclusions about the chronic effects of air pollutants on the health of urban dwellers. This isolated instance does, however, demonstrate that an air pollutant can have chronic effects on health. It also demonstrates that these effects were obtained from concentrations of the chemical pollutant many times below those considered as "safe" for occupational exposures.

We have more information about acute effects from studies of the Meuse Valley disaster of 1930, which was responsible for 60 deaths; the smog of 1948 in Donora, Pa., which killed 20 persons and caused symptoms of varying degrees of severity to 40 percent of the population; and the London fog of December 1952, which accounted for the death of a large number of persons. One fact is clearcut. The deaths and illness observed during these incidents were due to chemical pollutants of the atmosphere and not to other causes.

By Mary O. Amdur, Ph.D., formerly research associate of the Harvard University School of Public Health.

Special Group Affected

The greatest number of fatalities and the most severe illness were found in the older age groups and in persons with heart disease, chronic bronchitis, bronchial asthma, and pulmonary emphysema. During such disasters, the young, healthy, normal individuals will be inconvenienced possibly, but a smaller percentage of them will suffer major injury.

Whether or not persons with pre-existing cardiac and respiratory pathology are harmed by the normal levels of urban air pollution we do not know. That they are damaged by the levels of pollution during the special situation of these fogs has been established. When an explanation of such disasters is sought, these unusually susceptible persons must be kept in mind.

Measurements of the concentrations of sulfur dioxide and smoke made in London during the fog and calculations made after the Meuse Valley and Donora incidents reveal that the concentration of pollutants was not excessively high. They were, of course, much higher than those normally found in the atmosphere, but they were nowhere in the range normally considered lethal or injurious. The concentrations did not even approximate the so-called maximum allowable concentrations—the levels industrial hygienists regard as safe for an exposure of 8 hours a day for workmen in industry.

The maximum allowable concentration of sulfur dioxide is 10 p.p.m. The calculated concentration was about 8 p.p.m. for the Meuse Valley and 0.5 p.p.m. for Donora. The measured average sulfur dioxide for the peak day of the London fog was 1.3 p.p.m. This concentration is about 10 times the amount normally found in London, but on the other hand, it is still only a tenth of the maximum allowable concentration.

How then can atmospheric pollutants produce such widespread injury and mortality at concentrations not normally considered harmful? At first glance it seems surprising that this should be so. To some it is even tempting

to conclude that this pollutant or that one could not possibly have contributed to the overall picture because industrial exposures to much higher concentrations have supposedly caused no harm to workmen over a period of years.

But are the industrial workman and the person injured during the fog really comparable? For several reasons, I feel that the answer is no.

These maximum allowable concentrations are intended as a guide for levels of exposure of individuals healthy enough to be engaged in factory work in the first place. Persons with cardiac or respiratory pathology of any severity are not as a rule found in occupations in which respiratory irritants are encountered routinely. Hence, the MAC values are designed to protect the average and not the highly susceptible individual. It is these very persons, however, with whom we must be concerned in fog disasters.

It is also a well-known fact that a tolerance of a sort is developed by persons working routinely in the presence of respiratory irritants, as witness the pathologist who works happily in a concentration of formaldehyde vapor which at once brings tears to the eyes of his visitor.

Atmospheric Mixture

In addition to dealing with a special group of persons in fog disasters, we are also faced with a very special atmospheric situation. A meteorological inversion has stabilized a mass of air over the area. This same air remains there for 3 or 4 days. The situation can be likened to a pot of a given volume containing a mass of cold foggy air sealed in by a lid.

Since the volume remains constant and many pollutants continue to be added, the concentration of pollution continues to rise until the meteorological situation changes and the fog is dissipated. There is every possibility of interaction among the various pollutants. Gases may be adsorbed on solid particles such as smoke or dust. The water particles provided by the fog itself offer another medium to dissolve gases and promote various interactions. A great deal more information is needed about the chemistry and physics of such a mixture.

We also know very little about the physiological action of the various individual pollutants at concentrations corresponding to those occurring in the fogs. And we know very little about the interaction of two or more pollutants.

Working out methods of establishing and sampling experimental atmospheres containing known concentrations of pollutants can be time consuming, especially when very low concentrations are needed. To control, establish, and measure accurately concentrations of two or more materials at once poses even more problems. Careful control of physiological measurements is also an essential of such studies since various psychological factors must be eliminated if the results are to have any real meaning.

From such research will come no dramatic "answers" to the fog, but rather, bit by bit, information will accumulate on the effects of low levels of the common pollutants and on the interactions among them. It has been agreed that there was no single causative agent in the fog disasters studied. On the other hand, to claim that a given pollutant did not contribute to the picture because it was not the whole answer would be fallacious.

Experimental Studies

In Los Angeles the research group, headed by Haagen-Smit, has worked out methods for detailed chemical analysis of the atmosphere so that reasonably complete information is available about the compounds and the amounts present.

Further studies have shown that in Los Angeles the smog constituents responsible for eye irritation and injury to plants result from the interaction of ozone or nitrogen oxides with unsaturated hydrocarbons. The resultant organic peroxides and other oxidized compounds have a high irritant potency. These reactions have been studied under controlled laboratory conditions and the experimental atmosphere thus produced has had effects similar to those observed during the fog. The study of individual organic compounds has made it possible to determine which ones are the most likely to cause this type of trouble and which ones should be reduced to a minimum during smog conditions. Through this work a definite group of

airborne organic substances has been linked with injury to man for the first time.

The Army Chemical Center, Edgewood, Md., has demonstrated the effect of physiologically inert aerosols on the toxicity of irritant gases. In cases in which the aerosol increased the penetration of the gas to the lungs, the toxicity was increased. Formaldehyde was an example of this type. When the aerosol decreased the penetration to the lungs, it also decreased the toxicity. This was true for nitric acid fumes. With acrolein vapor, the aerosols had a variable effect on the toxicity. This experimental demonstration that the toxic effect of a gas may be influenced by the presence or absence of aerosol particles had practical as well as theoretical value.

A group of investigations in progress at Harvard University during the past 4 years have been concerned in general with the physiological effects of the sulfur compounds on guinea pigs and man. It has been well established that nobody in industry seemed to suffer any harm from routine exposures to sulfur dioxide concentrations up to 10 p.p.m., but data were lacking on whether or not any physiological response resulted from the exposure of unacclimated persons to the concentrations found during the fog disasters. The industrial concentration of sulfuric acid mist had been set at 1 mg. per cubic meter. It had been suggested by various authorities that these two sulfur compounds had done their bit in contributing to the Meuse Valley and Donora episodes.

We found that 1 p.p.m. of sulfur dioxide breathed through a face mask for 10 minutes had a significant effect on the pulse rate, respiration rate, and tidal volume (volume per respiration) of normal persons. Under the same experimental conditions, a concentration of 5 p.p.m. of sulfur dioxide had no apparent effect on workmen routinely exposed to concentrations of above 10 p.p.m. Thus, the reaction of workmen accustomed to an irritant gas is not the appropriate standard by which to judge the reactions of an unacclimated individual, especially a highly susceptible one.

We found that sulfuric acid mist produces a response similar to that of sulfur dioxide at concentrations as low as 0.3 mg. per cubic meter (equivalent approximately to 0.1 p.p.m.).

Hydrochloric acid and acetic acid did not produce similar effects at low concentrations. Hydrochloric acid produced reactions at concentrations of 10 p.p.m. and above, but at this level the sharp smell is annoying. Acetic acid did not produce these responses at any level up to the 30 p.p.m. tested.

If each of the sulfur compounds alone has an effect, what do they do when both are present together? This is being studied on persons, but the experiments have not gone far enough for the results to be evaluated. Some preliminary information on guinea pigs showed that a given concentration of sulfur dioxide is much more damaging when a small amount of sulfuric acid is present with it. This showed up in the growth of the animals following exposure, in the pathology found in the lungs, and in the marked respiratory response of the animals to the combination. The concentrations used in this work were about 10 times the MAC values and about 100 times those found in the fog disasters. Either of the compounds alone at the concentrations used was relatively harmless to the guinea pigs when exposure was limited to 8 hours (see *Public Health Reports*, May 1954, p. 503).

New Jersey's State Program

PHR brief

An air sanitation program has been added to the industrial hygiene and radiological health activities of the New Jersey State Department of Health. The trio of programs is administered by the bureau of adult and industrial health.

In line with the philosophy of placing most of the responsibility for public health activity in the hands of local officials, the air sanitation program is designed to assist local governmental units in establishing control measures. It will also provide research facilities for evaluat-

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By William A. Munroe, principal public health engineer of the New Jersey State Department of Health.

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ing the degree of air pollution existing throughout the State and will develop air sampling and testing procedures to meet State problems.

Assistance in Local Control

The State air sanitation program plans to provide local governments with the facts available about air sanitation control. When the condition warrants, studies will be made to determine the nature of the problem and to determine the extent of legal or technical control currently practical. From time to time, the department will develop model ordinances which can be adopted by local boards of health by simple legal process. The 1953 smoke control code of New Jersey is one example of this form of legislation.

This smoke control code is designed to provide local boards of health with a form of smoke control they can enforce with personnel and facilities available to them. Replacement or elimination of more detailed and specific local smoke control ordinances which the larger cities or heavy industrial areas may have or require is not intended.

When requested by municipal officials, the State air sanitation officials will express opinions on plans for new structures or on air pollution controls proposed for old structures.

Air Sanitation Research

The development of techniques for measuring air pollution is a big job and one that is being carried out by many organizations in the country. However, we feel that we can make some contribution to air sampling methods as the needs are indicated by specific problems in New Jersey.

The program has developed or modified numerous devices for outdoor air testing, usually as the result of some particular field problem in which the need for a method was indicated. Two experimental field mobile air sampling units have been constructed for use as field laboratories. The equipment in both of these units is the result of applied research and field experience with the type of air sanitation problems existing in New Jersey. Much of the scientific equipment used in field studies are air sampling and testing devices or modifications of the type of device used in industrial hygiene inplant evaluation of air contamination.

The importance of meteorology in concentrating or dispersing air contaminants has been well established. The health department field units are equipped with recorders for making continuous records of local meteorological conditions for correlation with atmospheric sampling data.

The most promising device developed by the program is an automatic directional air sampler that is capable of collecting air samples, by conventional sampling devices, in such a manner as to correlate the sample with a specific sector of the compass. The department is also working on an attachment for the Thomas recorder which will automatically collect a gas sample when a pre-established level of sulfur dioxide is indicated on the recorder and will automatically correlate the sample with wind direction.

Field studies will also be made to correlate cause and effect of industrial air pollution. One such study is in the advanced planning stage and will be started as soon as facilities permit.

Technical Assistance

Many municipalities in New Jersey have ordinances which control air pollution from the viewpoint of nuisance as well as health hazard. However, no municipality in New Jersey is equipped to get the technical evidence needed for legal action. When requested, the facilities of the department of health will be made available to assist in the collection of technical evidence.

The State air sanitation officials are frequently requested by local officials to meet with them and representatives of industrial management to discuss a local problem. We have found this to be most satisfactory and plan to continue the procedure.

The State program is also frequently requested to evaluate the effectiveness of one form or another of air pollution control on a plant process. It is equipped with stack sampling facilities and provides this service within the limits of time and staff upon request by a local government. In some instances, stack sampling

is performed at the request of plant management.

The air sanitation program is not a law enforcement program. Rather it is set up to provide a service to local governments and to provide a latitude for research on the problem as it exists in New Jersey. But definite legal control is available in State public health law if, or when, an air sanitation problem becomes a health hazard. Whenever such a condition exists, the State department of health is obligated to use the legal powers available to it and to enforce existing provisions of State law.

However, no form of legislation has yet been successful in eliminating all forms of objectionable air contamination. There is much to be learned about the techniques of air sanitation control from the viewpoint of human tolerance, nuisance levels, and practical and economic engineering methods for abatement.

The forms of air contamination to be considered by the air sanitation program are: chemical pollutants from industrial processes; smoke from industrial, commercial, or domestic heating facilities; smoke from industrial or municipal incinerators or dumps; exhaust gases from motor vehicles; objectionable pollens; and other forms of manmade or natural contamination.

Contributions of Industry

PHR brief

The utility companies, I found in my trips about the country the past year, are the leaders in air pollution control, as they should be, even when the plants are quite a distance from residential areas.

The utility companies serving Boston, Chicago, Cleveland, Baltimore, Charleston, W. Va., and Sunbury, Pa., for example, are all engaged in about the same type of air pollution control as the Consolidated Edison Company, main supplier of gas and electricity for factory, business, and home use in New York City and its environs.

Unlike most other large cities, New York City does not have many large industrial plants generating their own electricity. To a large extent the stacks of industry in New York City are the stacks of Consolidated Edison. The company uses approximately one-third of all fuel, one-half of all coal, and two-thirds of all bituminous coal burned in the city.

Control Equipment Costly

In 1937, Consolidated Edison embarked on an ambitious program of installing modern devices and revamping older control equipment. From 1937 to date the total cost of the control program for work completed and authorized comes to $31 million. Four million dollars of this amount is earmarked for work scheduled but not yet done.

During the past year substantial progress was made in the continuing program of installing improved control equipment at five stations of the system. At the East River station alone, for instance, the installation of mechanical control equipment and the revamping of older type electrostatic precipitators on three 1-million-pound boilers installed about 1929 has cost nearly $900,000 and is two-thirds completed.

As new generating units are added, a large part of their cost will be for modern control equipment. At the new Astoria station in Queens, for example, the cost of air pollution control equipment, both mechanical and electrostatic, was well over a million dollars for each of the two boilers installed. At Astoria, the investment in plant is about $160 per kilowatt of installed capacity. Of this amount $5.94, or 3.7 percent, is for air pollution control equipment.

Solution for Low Stacks

Because of the proximity of the Astoria station to the LaGuardia Airport, where safety regulations limited the height of the new station's stacks to 300 feet above sea level, special

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By George T. Minasian, director of community relations of the Consolidated Edison Company of New York, Inc.

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engineering problems were presented in getting sufficient velocity into stack emission to lift it high above the surrounding buildings. To find the solution, research engineers built a special wind tunnel, and for 2 years tests and analyses were made at New York University. As a result, we built a new type of stack with a nozzle installed on the top. Inside this nozzle, and concentric with it, is a second nozzle with damper. This damper is operated to increase the velocity when weather, wind, or plant conditions might create an unpleasant situation. Part of the installation is an atmosphere analyzer located in the direction of the housing development near the plant and a wind velocity and direction gauge on top of one of the nearby gas holders. A television viewing monitor on the central control board shows the operators at all times the condition of the stacks.

I also have a good report on our Staten Island plants. Livingston, a standby and peak-load station, burns oil, and the modern, highly efficient Arthur Kill station is equipped with electrostatic precipitators, and we have a beautifully clear stack (which I am afraid distinguishes it from many of its neighbors on the other side of the Kill; I am not giving away any secrets as any of you who travel the New Jersey Turnpike can testify).

Automatic load frequency control is now operative systemwide, an investment, incidentally, of $288,000. On the console at the control center, it is possible to preset the system for proportional participation by the various stations in load changes, including ties to the north and to Long Island. This device helps greatly in controlling the effect of load swings on stack discharge since the settings are made with this in view.

Consolidated Edison's problem is not smoke in the engineer's sense—unburned carbon—since we burn our fuel efficiently. It is not noxious fumes since products of combustion are discharged high in the air at high velocity and are so dissipated that any concentration from such sources is infinitesimal at habitable levels compared with other sources such as automobiles and buses. Our problem is fly ash, the unburnable part of our fuel, most of which would find its way into the atmosphere if it were not caught. With our control equipment we are catching about 95 percent of the fly ash.

Notes Progress

How about industries other than the utility plants? It may not be so uniformly apparent that they are making progress in air pollution control, but I am convinced that they are. I have been particularly interested in "The Magic Valley," in Charleston, W. Va., where the many large companies include Union Carbide, DuPont, American Viscose, Libby-Owens-Ford, and Libby-Illinois. All of these companies have extensive air pollution control programs and have the support of the citizens and the press.

At Baltimore, during the meeting of the Air Pollution Control Association in May 1953, there was of course the usual evidence of a heavy industrial concentration. However, programs were being set up in the various industries. By far the worst smoke that we saw was on the pleasure boat on which most of the smoke control officials took an inspection and pleasure trip on Chesapeake Bay.

I might also mention Pittsburgh, which is still getting bouquets I sincerely believe it deserves. However, these bouquets also are deserved chiefly for the great progress made and should not be interpreted to mean that the millennium has come and that the city is free from air pollution. I feel quite optimistic about industry as a whole insofar as it is cooperating and showing sincere interest in doing its part for cleaner air.

Cariostatic Effect and Metabolism Of Ammonium Fluosilicate

By I. ZIPKIN, Ph.D., and F. J. McCLURE, Ph.D.

THE EQUAL EFFECTIVENESS of sodium fluosilicate and sodium fluoride in reducing dental caries in the white rat, given at a level of 50 p.p.m. fluorine in drinking water, has been demonstrated by the National Institute of Dental Research, Public Health Service (*1*).

Although sodium fluosilicate, Na_2SiF_6, is cheaper than sodium fluoride, NaF, its use for the fluoridation of municipal water supplies may be limited to some extent by its solubility. Ammonium fluosilicate, $(NH_4)_2SiF_6$, is considerably more soluble than either of these two fluorine compounds, and it is also cheaper than sodium fluoride.

The price (*2*) of the three fluorine compounds and their solubility (*3*) are as follows:

	Price in cents		*Solubility*
	Per lb.	*Per lb. of F*	*Gm. per 100 gm. H_2O at 17.5° C.*
Na_2SiF_6	7.0	10.6	0.65
$(NH_4)_2SiF_6$	11.0	16.0	18.5
NaF	11.5	25.5	4.3

The high solubility and high fluorine content of ammonium fluosilicate make it especially useful in small water plants. It may be used in either liquid or dry chemical feeders. By a special process, it has been made free flowing to prevent clogging of the dry feeder (*4*). The treatment of some water requires the addition of ammonia to reduce the odor and taste, and in this case ammonium fluosilicate may be particularly applicable because it may eliminate the ammoniation operation. It appears, therefore, that ammonium fluosilicate would meet the engineering requirements common to most fluoridation installations as described by Maier (*5*, *6*).

In addition, a fluorine compound suitable for fluoridation must meet certain physiological requirements. This study, therefore, presents laboratory data on physiological properties of ammonium fluosilicate pertinent to its use as a practical water fluoridating agent. Sodium fluoride was used as a basis of comparison.

The properties studied in the growing white rat were: (*a*) the inhibition of dental caries; (*b*) development of incisor striations; (*c*) the deposition of fluorine in bones and teeth; (*d*) calcification of bones as determined by ash content; (*e*) average daily weight gain; and (*f*) any gross evidence of untoward physiological effects.

Dr. Zipkin is a biochemist, and Dr. McClure is chief, Laboratory of Oral and Biological Chemistry, National Institute of Dental Research, National Institutes of Health, Public Health Service.

Materials and Methods

The sodium fluoride used in this study was an analytical grade reagent and its purity was accepted according to assay. The purity of the

Table 1. Daily gain in weight, caries inhibition, deposition of fluorine, and percent ash in bones and teeth of rats receiving distilled water and different fluoride solutions

Item	H_2O	NaF	$(NH_4)_2SiF_6$	NaF+ Na_2SiO_3+ $(NH_4)_2CO_3$
Number of rats	22	24	21	23
F intake (mg.)	0	60. 7	59. 8	59. 9
Days on experiment	99	99	99	99
Initial weight (gm.)	50	50	51	49
Final weight (gm.)	190	190	180	185
Average daily gain (gm.)	1. 4	1. 4	1. 3	1. 4
	Caries diagnosis			
Number rats with caries	19	15	13	15
Percent rats with caries	86. 4	62. 5	61. 9	65. 2
Number carious teeth per carious rat	3. 0	2. 3	2. 4	2. 3
Number carious areas per carious rat	6. 2	3. 1	3. 2	2. 8
Caries score per carious rat	14. 1	6. 6	6. 7	5. 6
Fluorosis index	0	1. 9	2. 0	2. 0
	Percent fluorine in bones and teeth (ash basis)			
Molars	. 006	. 216	. 226	. 236
Incisors	. 002	. 168	. 180	. 163
Mandibles	. 005	. 419	. 439	. 430
Femurs	. 005	. 452	. 462	. 477
	Percent ash in bones and teeth			
Molars	75. 8	76. 1	75. 6	75. 3
Incisors	76. 1	76. 0	76. 5	75. 7
Mandibles	70. 0	71. 3	70. 7	71. 1
Femurs	63. 9	63. 1	64. 3	64. 8

ammonium fluosilicate was assessed by analysis for F, Si, and N (Kjeldahl), and the percent of theoretical purity found was 101.7, 96.0, and 100.1, respectively.

Thirty litters of four female weanling Osborne-Mendel rats were divided into 4 groups of 30 rats each. Group I received distilled water (control); group II received 50 p.p.m. F as NaF; group III received a solution of $(NH_4)_2SiF_6$ containing 50 p.p.m. F; and group IV received a composite fluoride solution of the following composition: 0.1105 gm. NaF, 0.3538 gm. $Na_2SiO_3 \cdot 9H_2O$, and 0.0421 gm. $(NH_4)_2CO_3$, made up to 1 liter. The composite solution contained 50 p.p.m. F and furnished a concentration of silicon and ammonium ion equivalent to that provided by the ammonium fluosilicate solution. Use of this solution made it possible to observe the relation of these ions to the effect of fluoride. The pH of all drinking solutions was adjusted to 5.5–6.0. The cariogenic diet (*1*) and all drinking fluids were ingested ad libitum, and fluoride intake was equalized throughout the experiment by substituting distilled water for the fluoride drinking fluid for short periods of time.

At the end of 99 days the surviving animals were killed and the molar teeth scored for dental caries according to Cox and associates (*7*). The degree of incisor fluorosis was arbitrarily scored 0, 1, 2, or 3, that is, none, mild, moderate, and severe, and a mean fluorosis index was calculated for each group. The femurs, mandibles, and molar and incisor teeth of 10 rats of each group, nearest the mean weight for that group, were pooled by tissue, dried, extracted with alcohol and ether, and ground to pass through a 60-mesh sieve. All tissues were then ashed at

550° C. for 3 hours and analyzed for fluorine (*8, 9*).

Results

The caries inhibiting effect of the fluoride solutions and the deposition of fluorine in the bones and teeth are shown in table 1.

There was no gross evidence of toxicity in the rats receiving either ammonium fluosilicate or sodium fluoride, and the average daily weight gains were comparable for each group. In addition, no difference was found in the severity of fluorosis produced in the three groups of experimental rats receiving the different fluoride solutions. The fluorosis indexes for the four groups of rats were 0.0, 1.9, 2.0, and 2.0, respectively (table 1).

Ammonium fluosilicate was as effective as sodium fluoride in inhibiting caries. There was a 28.4 percent and 27.7 percent reduction in the caries incidence and a 52.5 percent and 53.2 percent reduction in the caries score per carious rat in the animals receiving the ammonium fluosilicate and sodium fluoride solutions, respectively.

The chi square test was used to test the difference in the caries incidence between the control and treated rats according to the following formula:

$$\chi^2=\frac{T(AD-BC-T/2)^2}{(A+B)\ (C+D)\ (A+C)\ (B+D)}$$

where T=Total number of rats (90)
A=Number of carious control rats (19)
B=Number of noncarious control rats (3)
C=Number of carious experimental rats (43)
D=Number of noncarious experimental rats (25)

The difference was found to be significant at the 5 percent level using a one-sided significance test ($\chi^2=3.14$).

The caries scores per carious rat, shown in table 1, were compared by analysis of variance (*10*), and the probability (p) values are found in table 2.

For each of the caries categories tested as shown in table 2, the caries results for the experimental groups are significantly lower (table 1) than those for the control group, and no significant differences exist between the groups receiving different fluoride solutions.

No significant differences are apparent in the deposition of fluorine in the bones and teeth of rats on the various fluoride regimens (table 1). Similarly, no significant differences are found in the ash content of bones and teeth of rats on the various fluoride regimens. These current data on caries inhibition, fluorine deposition, and ash agree closely with similar data obtained in a previous study (*1*).

Table 2. Statistical comparison of caries experience: "p" values of differences between groups

Group	Carious teeth per carious rat	Carious areas per carious rat	Caries score per carious rat
Significance of differences between control and experimental fluorine groups	<0.05	<0.01	<0.01
Significance of differences between experimental fluorine groups	$>.05$	$>.05$	$>.05$

Hence, it appears that ammonium fluosilicate and sodium fluoride were similar with respect to all the criteria investigated. There were no significant differences in the average daily weight gains, the degree of fluorosis, the reduction of dental caries, and in the amounts of fluorine and ash deposited in the bones and teeth.

Discussion

It is not surprising that ammonium fluosilicate proved to be similar to sodium fluoride at a level of 50 p.p.m. F in drinking water in its cariostatic effect and in its ability to deposit fluorine in bones and teeth of the white rat. Previous comparisons between sodium fluoride and sodium fluosilicate at 50 p.p.m. F in drinking water have shown no differences in the amount of fluorine deposited in bones and teeth (*8*), in the extent of incisor fluorosis, and in the reduction of caries (*1*).

Theoretically, ammonium fluosilicate would yield fluorine ion quantitatively upon hydrolysis according to the following scheme (*11*):

$$(NH_4)_2SiF_6 \rightleftharpoons 2NH_4^+ + SiF_6^=$$
$$SiF_6^= + 2HOH \rightarrow SiO_2 + 6F^- + 4H^+$$
$$(NH_4)_2SiF_6 + 2HOH \rightarrow 2NH_4^+ + 6F^- + 4H^+ + SiO_2$$

These reactions also indicate that solutions of ammonium fluosilicate would have an acid reaction and in fact did have a pH of 3.4–3.6.

In an acid medium, such as the gastric juice, the silicon of Na_2SiO_3 would be present as SiO_2 and hence should react like the silicon of $SiF_6^=$ according to the following reactions:

$$Na_2SiO_3 \rightleftharpoons 2Na^+ + SiO_3^=$$
$$SiO_3^= + 2H^+ \rightarrow SiO_2 + H_2O$$
$$Na_2SiO_3 + 2H^+ \rightarrow 2Na^+ + SiO_2 + H_2O$$

The composite solution was similar to the ammonium fluosilicate and sodium fluoride solutions according to the criteria investigated. It appears, also, that neither the ammonium ion nor silicon interfered with the physiological reactions characteristic of the fluoride ion.

The results of this study indicate, therefore, that $(NH_4)_2SiF_6$ is hydrolyzed in dilute solution and behaves physiologically like the solution of NaF.

Conclusions

1. A comparison was made of the ability of sodium fluoride, NaF, and ammonium fluosilicate, $(NH_4)_2SiF_6$, solutions containing 5 p.p.m. F to reduce caries and deposit fluorine in the bones and teeth of the white rat.

2. No differences were observed in the amount of fluorine and ash deposited in the molars, incisors, mandibles, and femurs.

3. There was no difference in the rate of growth among all groups of rats.

4. There was no difference in the production of incisor striations.

5. Ammonium fluosilicate was as effective as sodium fluoride in inhibiting caries in the white rat.

6. The data suggest that ammonium fluosilicate may be equally as effective as sodium fluoride as a fluoride carrier for the fluoridation of municipal water supplies.

ACKNOWLEDGMENTS

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Woodruff Center in Connecticut

An Approach to the "Unadjusted Elderly"

By SIDNEY SHINDELL, M.D., LL.B.

AS THE NUMBER of "senile" or "unadjusted elderly" persons increases, the problem of overcrowding in State mental hospitals becomes progressively acute. Many of these aging people are not necessarily afflicted with illness or incapacity necessitating continuous medical or nursing care, nor can they accurately be termed "psychotic." But such patients are occupying beds in the mental hospitals which could be used more appropriately for people with acute mental illnesses. Too frequently in mental hospitals, these "senile" patients do not receive the type of care which might make it possible for them to resume near-normal activities in their usual environment.

Upon its completion, the new Woodruff Center at New Haven, Conn., will offer an opportunity for the Commission on the Care and Treatment of the Chronically Ill, Aged and Infirm, an agency of the State of Connecticut, to develop what it believes is a reasonable approach to the problems of caring for the elderly patient. The Woodruff Center will be an institution which will approach the problems of the elderly patient in a manner comparable to the approach to the physically disabled individual, rather than viewing the elderly patient as one whose problem is essentially psychiatric.

The Commission on the Care and Treatment of the Chronically Ill, Aged and Infirm was created by the Connecticut General Assembly in 1945 to alleviate overcrowded conditions in the State mental hospitals and to develop a broad overall rehabilitation program for the "unadjusted elderly." The assembly delegated the following powers and duties to the commission (*1*):

"The commission shall study the problems of the care and treatment of the chronically ill, aged and infirm persons in this State; shall initiate a program, with the cooperation and aid of State agencies concerned, to coordinate and develop existing resources for such care and treatment, and shall plan and . . . construct or purchase, lease or otherwise acquire . . . and staff and operate, such buildings as it deems necessary for the care of such persons . . . Said commission shall fix rates for care at such institutions and shall determine policies and adopt regulations necessary to carry out the provisions of this act."

In carrying out the duties assigned to the commission, Connecticut's rehabilitation program was designed to provide care for these four principal groups of the chronically ill and aged:

Group A. Persons who as a result of chronic illness or accident have a physical disability and require the specialized services of physi-

Dr. Shindell has, since December 1952, been medical director of the Commission on the Care and Treatment of the Chronically Ill, Aged, and Infirm, Rocky Hill, Conn., and also lecturer in medical jurisprudence at Yale University School of Medicine. He became a commissioned officer of the Public Health Service in July 1947, assigned first to the Georgia State Health Department, and then to the study of the home care program at Montefiore Hospital, New York City, and the direction of the home care unit at the District of Columbia General Hospital (formerly Gallinger Municipal Hospital) and in the Division of Chronic Disease and Tuberculosis of the Public Health Service.

cal medicine and rehabilitation as their primary need.

Group B. Persons who as a result of physical ailments of a chronic nature are expected to require definitive medical care for a prolonged period, with a reasonable expectancy of alleviation of their condition.

Group C. The so-called "seniles"—persons who as a result of age have demonstrated an inability to adjust reasonably to their usual environment and are considered cases of mild mental confusion but who do not have such mental aberrations as to be considered truly psychotic.

Group D. Persons derived from groups A, B, and C, who represent failures in terms of limitation of present medical knowledge but who continue to require at least custodial care.

Experience With the Physically Handicapped

The commission has experienced considerable success in giving "total" care to all persons in the A and B categories admitted to the existing facilities of the commission at Rocky Hill and New Britain, Conn. The principal facility now in operation, which was established in 1948, is at Rocky Hill, Conn.

At the Rocky Hill center, the program of physical medicine and rehabilitation includes the services of a complete rehabilitation "team," the basic medical and surgical staffs augmented by psychologists, psychiatrists, and medical social workers, as well as the physiatrists and physical, occupational, recreational, vocational, and educational therapists. The center is also used for training personnel for similar rehabilitation work in other locations.

Although the rehabilitation center at Rocky Hill has emphasized care to group A and group B patients, some incidental experience has been gained with group C patients—those who are classified as being the unadjusted elderly. It was on the basis of this experience, and with a view to more directly relieving the State mental hospitals, that the commission has designed the facility to be known as the Woodruff Center, which is described below.

The experience to date has indicated that in each of these groups of patients, there is need for graded physical activity, competent attention to medical needs, intellectual stimulation, and psychiatric guidance in varying degrees. The special physical and social handicaps of everyone in each of these categories require similar attention, and every one of these persons requires the kind of attention which negates his already prevalent belief that he has been rejected by society, family, and associates.

The rejection of the elderly occurs too frequently as an indirect result of urban living, with consequent lack of employment opportunities. In fact, many groups in our society view the aging person as one whose age is synonymous with physical disability. Many elderly persons therefore must depend on relatives, friends, or private and public agencies for financial support and sometimes for a certain amount of medical care. Little enough is done to make daily living for some more than a bare existence. As a result, too many aging people become discouraged, lose confidence, feel unwanted. They tend to become inactive physically and intellectually more rapidly than they might otherwise. Relatives and friends become discouraged too and impatient when an elderly person needs constant attention or supervision. When they can no longer provide the care needed, the person may be admitted to a mental hospital for lack of any other suitable facility.

The Woodruff Center

The commission is now designing its newest unit for both long-term definitive care as well as complete rehabilitation of the physically disabled and aging, to be known as the Woodruff Center. A former hospital building is being remodeled to provide the initial 135 beds which will be ready for occupancy in the fall of 1954. The construction of an additional 400-bed unit will begin a short time later.

Sixty of the initial 135 beds will be set aside for a controlled study of unadjusted elderly patients from the State mental hospitals. It is planned to draw, completely at random, 60 elderly patients from the mental hospitals—20 from each of the 3 State mental hospitals in Connecticut—at the time they seek admission to those institutions. A control group of another 60 patients, also selected at random, will be cared for routinely at the mental hospitals.

As some of the study patients at Woodruff are discharged, they will be replaced by similar persons who have spent some time in the mental hospitals and who will also have been selected at random. By comparing the progress made by these groups of patients, the commission hopes to gain further insight into the needs of this type of person in helping him readjust to his usual environment.

The 60 patients admitted to the Woodruff Center will be interspersed with 75 patients who are not in the "unadjusted elderly" classification but whose needs are in many respects similar. All of these patients will receive physical, occupational, educational, and recreational therapy as well as the services of a medical social worker, clinical psychologist, and of similar personnel. The need for each type of service in each case will be, of course, an individual matter.

In remodeling the existing building at Woodruff Center, an effort is being made to minimize the "institutional" atmosphere. Color, unrestricted visiting hours, family-style meals, a "buddy" system, informal staff identification, a minimum amount of "routine," and the like will be tried. Patients requiring definitive medical service will be interspersed with the physically disabled and elderly so that there are both a variety for the staff and a possibility of each patient's abilities counterbalancing his neighbor's disabilities.

The addition to the remodeled hospital facilities is now on the drawing board and is being designed chiefly to house the rehabilitative elderly patient. As now planned, this unit will be connected with the service areas of the hospital—the lobby, the physical medicine and rehabilitation department, and the recreational areas. Varied color schemes and the use of a series of different patterns of furnishings are being considered rather than standard hospital beds and other hospital furniture, as well as having patients bring with them a piece or two of their own furniture.

All activities will be away from the sleeping quarters, and meals will be served away from the bedroom area. There will be opportunities for both indoor and outdoor work and recreational projects. The activities will be not only diversional or recreational, but useful responsibilities as well will be placed on patients in order to restore their self-confidence and, hopefully, to bring about more acceptable emotional responses. In cooperation with community agencies, a sheltered workshop will be available.

When the new addition is ready for occupancy, the commission will determine who should make use of it solely on the basis of potential benefit to the patient. If the commission is to be successful in developing an approach to care and treatment that will relieve not only the mental hospitals but other institutional facilities of long-term custodial cases, it must concentrate on helping those who have a good potential for rehabilitation. When patients admitted to the commission's facilities reach maximum improvement, they will be discharged to the most appropriate environment available, including, of course, home care and foster homes. Eventually, additional provision may have to be made for those persons who in spite of the best services available still require permanent care—those are the patients previously described as group D. At the moment this function is being performed by the private chronic and convalescent hospitals throughout the State, which have approximately 5,000 beds.

A Long-Range Solution

The commission hopes that the Woodruff Center will be able to point the way to a long-range solution rather than having its program destroyed in a rush to alleviate the problems of overcrowding in other institutions. There is little doubt on the part of the commission that with the right tools—in terms of specially designed facilities including the personnel necessary for an active program—rehabilitation of a good portion of the elderly is a realizable goal.

Obviously, institutions, of whatever kind, do not offer a complete solution to the problems presented by the chronically ill and aged. Their adequate care and treatment require the cooperative efforts of all individuals and agencies in any way concerned with their place in society. A facility such as that which is visualized for the Woodruff Center can accomplish little unless it is related to community activities which can follow through and return the rehabilitated

elderly to their rightful permanent place in their communities.

Recognition of the principle that local efforts must be developed has resulted in broadening the scope of the commission beyond the responsibility for operating facilities such as those at Rocky Hill and the Woodruff Center. The commission also has grant-in-aid funds at its disposal which have thus far been used mainly in assisting private, nonprofit hospitals in Connecticut to improve their standards of care for chronically ill and aged persons.

These funds are now being made available for the development of local efforts in home care programs, protective workshops, foster home programs, and the like. Care and continued therapy in such situations can give the disabled and elderly a more satisfactory opportunity for adjustment as contributing members of society.

To strengthen existing resources further, the commission has made available, in cooperation with the State health and welfare departments, a 10-week training course for operators and personnel of private chronic and convalescent hospitals, in order to aid in the development of better standards of care in those facilities.

This sharing of responsibility for an individual in need of care, using the type of facility which is appropriate to the individual case, will, it is believed, permit the facilities operated directly by the commission to remain relatively short-term rehabilitation units. It will also permit each group to contribute to an overall plan which will result in maximum benefits to the older citizens of Connecticut.

REFERENCE

(*1*) Connecticut General Statutes, 1949 revision, sec. 4194.

Course in Laboratory Diagnosis of Tuberculosis

A 2-week course in the laboratory diagnosis of tuberculosis will be offered November 15–26, 1954, by the Public Health Service at the Bacteriology Laboratories of the Communicable Disease Center, Chamblee, Ga. Reservations should be made well in advance.

Practical laboratory training in all phases of tuberculosis bacteriology, including preparation of culture media, microscopy, cultural procedures, diagnostic use of animals, and testing of drug sensitivity, will be offered. The course is open to all grades of employed laboratory personnel who are approved by their State health officers. Laboratory directors and senior laboratory staff members may also apply.

Application forms may be obtained from Laboratory Training Services, Communicable Disease Center, Public Health Service, P. O. Box 185, Chamblee, Ga. No tuition or laboratory fees are charged.

Population Losses Through Death, 1941–51

By LILLIAN GURALNICK, M.Sc.

THE DEPARTMENT OF DEFENSE has recently released figures on the number of deaths among the armed forces during the years 1941–51, tabulated by age and sex. These figures make possible the first complete assessment of the losses in the population of the United States, by age, during the disturbed years since 1941.

The laws of the 48 States and the District of Columbia require that every death occurring within their boundaries be reported. From these records, our national mortality statistics are produced. It is likely that a few deaths in remote rural areas where family burial plots are still used are never reported. On the other hand, the reported figures include deaths among visitors and employees of foreign governments in this country and exclude deaths among our nationals overseas.

In "normal" years, a death rate based on the deaths occurring in the United States and on the population estimated to be residing in the country is entirely satisfactory as a measure of the loss of population through death. The few deaths of American citizens abroad that are omitted or the deaths of foreign citizens here temporarily that are included have no serious effect on the final figures. But in the years since 1941, large numbers of the population have been overseas. There were 281,000 persons outside the country in July 1941. This figure rose to 7,447,000 in 1945. In July 1950, it was estimated to be 449,000, the smallest number since the end of World War II. The population overseas increased with our participation in the Korean war.

There is at present no complete count of the deaths among the overseas population. Deaths among the armed forces are recorded by the Department of Defense, and figures on the numbers of deaths have been released each year. Deaths of civilians are registered with the consular service, but no central collection of these figures is made. As complete a count as is possible of the annual loss of population is obtained when the deaths among the armed forces overseas are added to the deaths registered in the continental United States.

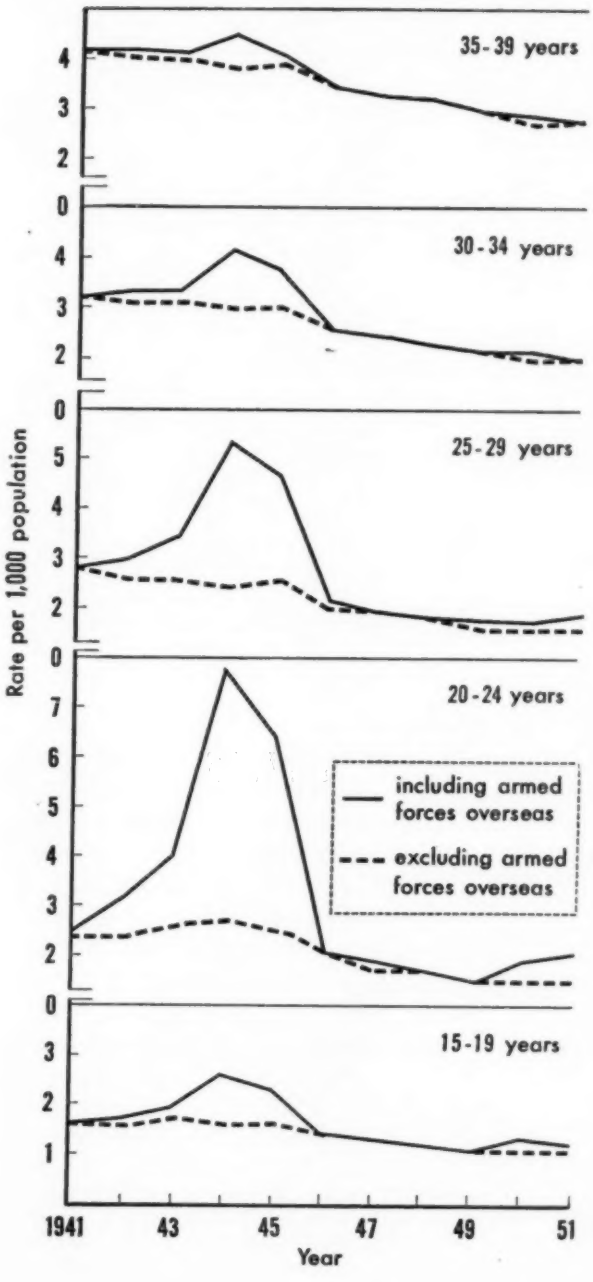
The crude death rates per 1,000 population based on deaths including those overseas and on the total population for each year, 1941–51, are shown below, along with the crude death rates computed from deaths and population excluding the armed forces overseas.

These figures show that the losses incurred during World War II and during the Korean

Year	*Including armed forces overseas*	*Excluding armed forces overseas*
1951	9. 7	9. 7
1950	9. 7	9. 6
1949	9. 7	9. 7
1948	9. 9	9. 9
1947	10. 0	10. 1
1946	9. 9	10. 0
1945	10. 8	10. 6
1944	11. 4	10. 6
1943	11. 0	10. 9
1942	10. 5	10. 3
1941	10. 5	10. 5

Miss Guralnick is an analytic statistician in the Mortality Analysis Branch, National Office of Vital Statistics, Public Health Service.

Death rates for total population at ages 15–39 years, United States, 1941–51.



engagement, while of tremendous personal and national consequence, had no large effect on the crude death rate for the population as a whole except in 1944.

The highest death rate in the period 1941–51 was recorded in 1944, when there were 170,000 deaths among military personnel overseas. Losses in 1945 were smaller. Since we were not at war during the entire year, it is likely that, on a monthly basis for the war period the death rate in 1945 was very close to that for 1944. Even though figures for 1946 include persons declared dead after having been missing in action more than a year, the mortality rates for 1946, and for 1947–49, including deaths and population overseas, were at the same level as the rates for the continental population.

Rates by Age and Sex

The impact of the war fatalities is seen more clearly in the death rates by age. The chart compares the death rates obtained for the continental United States, based on the deaths and population present in the country, with the rates for the total population, which is computed from all deaths, in the United States and overseas, for each age group from 15–39. A few deaths overseas were recorded at higher ages, even above 60 years; but most of the deaths (and the population) fell between the ages of 18 and 40. The death rates for each age group between 15 and 39 years were affected, and the extent of the change is shown in the chart.

The chart shows that there was also an increase in the rates for the continental population during the war years. In part, this change is an artificial one, resulting from the withdrawal of large numbers of young men for service overseas. The population remaining in the United States included those subject to higher mortality risks from natural causes. The number of deaths occurring among the younger age groups in the country was thus not likely to decrease appreciably, while the number of persons on which the death rate was based declined sharply. In addition, deaths in this country at these ages were increased somewhat during the war years by accidents in military training, industry, and transportation.

The population overseas during 1941–51 consisted almost entirely of men. The greatest number of women outside the country was 51,000 in 1945; and the total number of reported fatalities of women in the armed forces overseas, 1941–51, was less than 250. The death rates for women will not differ whether they

Table 1. Death rates [1] for men by age: United States, 1941–51

[Rates per 1,000 population in each specified group]

Age groups	Rates										
	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941
15–19 years:											
Including deaths and population overseas	1.7	1.9	1.5	1.5	1.6	1.8	3.4	3.5	2.4	2.1	2.0
Excluding deaths and population overseas	1.4	1.4	1.5	1.5	1.6	1.8	2.0	2.1	2.1	1.9	2.0
20–24 years:											
Including deaths and population overseas	3.3	2.8	2.0	2.2	2.3	2.7	11.3	12.2	6.2	4.6	3.0
Excluding deaths and population overseas	2.0	1.9	2.0	2.2	2.3	2.6	4.2	4.1	3.6	2.9	2.8
25–29 years:											
Including deaths and population overseas	2.4	2.2	2.0	2.2	2.3	2.5	7.6	7.7	4.7	3.9	3.1
Excluding deaths and population overseas	2.0	2.0	2.0	2.1	2.3	2.4	3.5	3.1	3.0	2.9	3.0
30–34 years:											
Including deaths and population overseas	2.5	2.5	2.4	2.6	2.7	3.0	5.2	5.2	3.9	3.9	3.6
Excluding deaths and population overseas	2.4	2.4	2.4	2.6	2.7	2.9	3.7	3.5	3.5	3.6	3.6
35–39 years:											
Including deaths and population overseas	3.4	3.4	3.5	3.7	3.8	4.0	5.0	5.0	4.7	4.9	4.8
Excluding deaths and population overseas	3.3	3.4	3.5	3.7	3.8	4.0	4.6	4.4	4.6	4.7	4.8

[1] Based on deaths registered in the United States and on provisional records of the Department of Defense. Deaths at unknown ages not included.

are computed for the continental United States, or for the total population.

The rates for men show clearly the losses sustained during World War II and the Korean engagement. The rates which include the deaths and population overseas are shown in table 1 along with the rates for the continental United States, by age. The excess mortality was greatest for the age group 20–24. In 1944, when the peak figure was recorded, the rate including deaths overseas (12.2 per 1,000 population) was 3 times the death rate for the continental United States. The rate for the 25–29-year-olds was more than doubled in 1944, and for ages 15–19 and 30–34, the figures were about 1.5 times the comparable continental rate in that year.

Age-Adjusted Rates

In a "normal" year, such as 1948, deaths of men 15–39 years old represent less than 5 percent of all deaths, so that even a considerable increase in these figures does not have a very great effect on a rate computed for the total population. This was evident in the crude death rates shown earlier. The effect of the military losses on the age-adjusted rates, when the age distribution of the population in 1940 is used as the standard, is greater, chiefly because the proportion of the population in the age groups 15–39 years was larger in 1940 than it has been in subsequent years. The death rates that would have been obtained had the age distribution of the population remained that of 1940, while the age-specific rates for each year pre-

Table 2. Age-adjusted death rates per 1,000 population

Year	Total population		Men	
	Including armed forces overseas	Excluding armed forces overseas	Including armed forces overseas	Excluding armed forces overseas
1951	8.4	8.3	10.1	9.9
1950	8.5	8.4	10.1	10.0
1949	8.5	8.5	10.1	10.1
1948	8.8	8.8	10.3	10.3
1947	9.0	9.0	10.5	10.5
1946	9.1	9.1	10.6	10.6
1945	10.1	9.4	12.4	11.1
1944	10.8	9.7	13.3	11.2
1943	10.4	10.1	12.1	11.6
1942	10.1	9.9	11.7	11.4
1941	10.3	10.3	11.7	11.7

vailed, are shown in table 2 for the experience including and excluding the armed forces overseas. The general downward trend in mortality, both for men and for the total population, was interrupted for the years 1943–45.

Summary

The effect of the deaths among the armed forces overseas on crude, age-adjusted, and age-specific rates for the United States has been shown for the years 1941–51.

Syphilis Serology Courses

The Public Health Service is offering six 2-week refresher courses on the laboratory techniques of the serology of syphilis at the Venereal Disease Research Laboratory in Chamblee, Ga., from September 1954 through April 1955. The courses are arranged to meet the needs of senior operating personnel from State laboratories, health departments, Federal Government installations, and of accredited representatives from other countries desiring refresher rather than fundamental training. Lectures, demonstrations, quizzes, discussions, and performance of the tests by the students are included in the courses which are designed to acquaint students with the methods most widely used in the United States for the serodiagnosis of syphilis. A third week of intensive training is available after each scheduled course.

In addition, a 2-week course on the management and control of syphilis serology by the regional laboratory is scheduled for May 2–13, 1955. Especially arranged for assistant laboratory directors and senior laboratory staff members, the course includes review of interlaboratory training programs, regional laboratory evaluation studies, laboratory inspection procedures, demonstration of antigen check-testing, and control serum preparation.

The refresher courses on serology of syphilis are scheduled as follows:

Sept. 13–24, 1954.	Jan. 31–Feb. 11, 1955.
Oct. 4–15, 1954.	Mar. 7–18, 1955.
Oct. 25–Nov. 5, 1954.	Apr. 11–22, 1955.

Applications should be addressed to: Director, Venereal Disease Research Laboratory, Division of Special Health Services, Public Health Service, Department of Health, Education, and Welfare, P. O. Box 185, Chamblee, Ga.

Water Quality of Swimming Places

—A Review—

By EUGENE L. LEHR, C.E., and CHARLES C. JOHNSON, Jr., B.S.

NEARLY FIVE YEARS have elapsed since the Joint Committee on Bathing Places of the Conference of State Sanitary Engineers and the American Public Health Association set forth its Recommended Practice for Design, Equipment, and Operation of Swimming Pools and Other Public Bathing Places. As a result of research, investigations, and experience since that time, articles have appeared in the literature which confirm, disagree with, or suggest modification of these recommendations. A review of these will be useful at this time.

Disease Transmission

No discussion of bathing water quality would be complete without reference to the extent and prevalence of disease transmitted by such waters. Although authorities agree that there is insufficient scientific evidence to prove a direct relationship between bathing water quality and illness among bathers, evidence suggests that such a relationship does exist (*1*).

Eye, ear, and nasal infections are common complaints of swimmers, with pinkeye, conjunctivitis, otitis media, colds, and sinus infections of particular concern. Other complaints include gonococcus infection of the eyes, schistosome dermatitis, sometimes called swimmer's itch, and gastrointestinal diseases. Schistosome dermatitis is not national in scope; it seems to be endemic in the upper midwest and is acquired only in natural bodies of water, which provide breeding places for the snails involved in the life cycle of the disease-producing organism.

Bathing waters have been suspected of transmitting poliomyelitis, although there is no proof of this. However, for elimination of all suspicion that bathing water plays any part in the spread of poliomyelitis or any other diseases, certain standards of safe water quality should be maintained.

Joint Committee Recommendations

Some of the recommendations for water quality set forth by the joint committee (*2*) are summarized below:

A. Chemical and physical quality (swimming pools).

1. Residual chlorine following disinfection: Free available chlorine, 0.4 to 0.6 p.p.m; or combined available chlorine (chloramine), 0.7 to 1.0 p.p.m.

2. Acidity–alkalinity: The pH of the pool should never be less than 7.0.

B. Bacterial quality (swimming pools).

1. Bacteria count on standard nutrient agar, 24 hours, 37° C., and confirmed test: Not more than 15 percent of the samples covering any

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considerable period of time shall contain more than 200 bacteria per milliliter, nor show positive test in any of five 10-ml. portions of water at the time the pool is in use.

2. The standard methods for the examination of water and sewage should be used in making chemical and bacteriological analyses.

3. The presence of streptococci in bathing waters is very undesirable, but their elimination with present-day recommended practices is considered impracticable.

C. Bacteriological standards for outdoor bathing places.

The committee emphasizes that final classification of water in natural bathing places should depend largely upon sanitary survey information. Findings from bacteriological analyses should be used only as a guide. The committee considers it neither practicable nor desirable to recommend any absolute standard of safety for the water based merely on bacterial or chemical analysis or on sanitary surveys. However, it did conclude that waters which show a concentration of most probable numbers of coliform organisms of less than 1,000 per 100 ml. are generally considered fairly acceptable for bathing, unless the sanitary survey should disclose immediate dangers from human sewage.

Coliform Density as an Index

Some other guides to permissible coliform densities in natural bathing waters are indicated in standards which have been adopted by official bodies of the areas shown in the table.

The Tennessee Valley Authority considers the numerical groupings it uses in appraising natural bathing water quality to be helpful as collateral criteria, but it considers such groupings to be of questionable value in the absence of sanitary surveys. The TVA does not subscribe to standards for swimming areas based on bacteriological data to the exclusion of sanitary survey data.

Thus, TVA suggests interpretation of the 0–50 coliform density as indicating a preferred classification not generally attainable, but recommends that, if such waters are found in the absence of an adverse sanitary survey, they may be selected for bathing areas without question.

The second density group of 51–500 is interpreted by TVA as a state of contamination presumably normal for inland streams free of sewage pollution, but which are subject to surface wash. It recommends that bathing be permitted in such areas in the absence of convincing adverse sanitary surveys.

The density group of 501–1,000 is viewed by TVA as indicating a water of suspicious quality which should be considered dangerous for bathing purposes in proximity to fresh sewage pollution, but which might be considered satisfactory if unfavorable conditions are not disclosed by a careful sanitary survey.

The TVA recommendation with respect to waters showing coliform densities above 1,000 per 100 ml. is that such areas should not be selected for swimming until further sanitary survey information discloses the origin of the high densities and that they are not due to fresh sewage contamination.

The question continues to arise as to why there should be so wide a variance between water quality standards for artificial pools and those for natural bathing areas. This is generally explained (*3*) by recognition of the difference in significance given to the presence of coliform organisms in natural waters and those in artificial pools. The source of water used in swimming pools is relatively free of coliform organisms in most instances. Therefore, the presence of these organisms in these pools must be regarded, usually, as of recent human origin. On the other hand, coliform organisms in natural waters may be of animal origin or from soil and, thus, of relatively less significance to public health.

The absence or presence of coliforms as an indication of bathing water quality has long been under attack. It has been recognized by early authorities (*4, 5*) that coliform organisms indicate merely the absence or presence of organisms from the intestinal tract. Their significance, therefore, is related primarily to intestinal diseases, which probably play only a minor role in the public health aspects of swimming pools. Gilcreas (*6*), Klassen (*7*), and Stevenson (*8*) have recently reiterated the need for an indicator organism which would reflect more closely the water quality needs of bathers.

Bacterial limits for natural bathing waters as recommended by 4 agencies

Water classification	Coliform density per 100 ml.			
	West Virginia	Great Lakes and Upper Mississippi River Boards	Tennessee Valley Authority [1]	New York State
Satisfactory for bathing	0–1,000	100–500	0–50	0–1,000.
Satisfactory with reservations		501–1,000	51–500	1,000–2,400.
Use doubtful; not recommended		1,001–10,000	501–1,000	50 percent of samples, over 2,400.
Do not use		10,001–100,000	Over 1,000	Evidence of infection from area.

[1] See text discussion of TVA on p. 743.

Studies on bathing water quality carried out by the Robert A. Taft Sanitary Engineering Center, Public Health Service (*8*), have furnished information as to the incidence of illness among bathers, by age, sex, and other groupings. They have demonstrated that higher incidence may be expected in the swimming group than in the nonswimming group, regardless of water quality. Eye, ear, and respiratory ailments have been shown to represent more than half of the overall illness incidence, with gastrointestinal disturbances accounting for up to one-fifth of illnesses among bathers, and skin irritations and other illnesses, the remainder.

Two instances of statistically significant correlation between illness incidence and bathing water quality were noted. Data were presented indicating that where the coliform count was high, gastrointestinal disturbances tended to increase. However, the author suggests that these results be used with caution, and concludes, also, that the observed results imply that some of the most rigid requirements for natural bathing waters could be relaxed without detrimental effect on the health of the bathers.

Following a bacteriological study of swimming pool waters from 13 pools, Albright and Rich (*9*) concluded that a check for hemolytic organisms in the water would be more important than one for coliform organisms. Lackey (*10*) has suggested that, since skin diseases, together with eye and ear troubles, are common complaints among swimmers, it might be worth while to develop a technique for field surveys to determine the causative organisms of such illnesses. He suggests, further, that any future bathing water surveys might well divide coincident illnesses into two categories: the enteric and the three groups of bacteria associated therewith, namely, coliforms, enterococci, and salmonella, could be one, and the other category might be eye, ear, nose, throat, and skin ailments and the organisms, including fungi, associated with them.

Disinfection Agents and Procedures

In 1948, Klassen and Sieg (*11*) described what they considered the ideal disinfecting agent for swimming pool waters. Klassen and Sieg's standards are:

1. Effective, residual, bactericidal action is obtained in the shortest possible time.
2. Effective, residual, bactericidal action is maintained throughout the body of water in the pool and its recirculation system.
3. Application equipment is simple, adequate, foolproof, and trouble free.
4. Dosage control is simple and accurate.
5. Agent and equipment are inexpensive.
6. Agent (after addition to pool water) is nontoxic and nonirritating to swimmers' eyes, skin, and mucous membranes.
7. Agent remains stable and effective through a wide range of varying conditions, such as pH, temperature, turbidity, organic matter, and mineral content.
8. Agent is colorless, odorless, tasteless, noncorrosive and has no adverse effect on materials likely to be immersed in the water.
9. Agent is compatible with chemicals commonly used in water treatment.

10. Complete and dependable research and experience have demonstrated that the agent has the above qualities.

Chlorine is generally considered to conform most nearly to these desired qualities. It is also the only disinfectant which has been approved by all State health departments for use in treating bathing waters. Bromine, another halogen which is somewhat like chlorine, has been approved recently by some States and might be considered to meet many of the requirements set forth above. Hendrickson (*12*) notes that bromine has been approved for use in New York, Wisconsin, Florida, and Illinois. Klassen estimates that approximately 10 percent of the Illinois pools are now using bromine. *Chemical Week* (*13*) reports that 1,000 pools in southern California are using bromine as the disinfectant of choice. Since California was not identified as having approved the use of bromine in public pools, it is assumed that this wide usage is confined to private pools.

Reports on bacteriological studies have indicated bromine to be about equal to chlorine for disinfection of waters which are fairly low in organic matter. One such study by Vandervelde, Mallmann, and Moore (*14*) presented the following conclusions:

1. Nearly the same bacteriological results were obtained from a residual of 0.5 p.p.m. of either bromine or chlorine.

2. Routine operation shows that about twice as much bromine, by weight, is needed to carry a residual of 0.5 p.p.m. than is required with chlorine.

3. Coli indexes are usually zero at normal residuals of bromine or chlorine.

4. Satisfactory equipment can be developed for applying bromine to swimming pools.

5. Irritation of the eyes does not result from either bromine or chlorine when used in normal concentrations.

There has been some discussion as to the efficacy of "high-free" chlorine residuals (equal to or greater than 1 p.p.m.) over what might be termed the normal, recommended free residual chlorine (0.4 to 0.6 p.p.m.). Mood and Robinton (*15*) and Mood (*16*) reported on a preliminary study of the bactericidal efficiency of high-free residual chlorine in swimming pool water concluding that:

1. High-free residual chlorination of swimming pool water produces bacteriological results within the maximum limit recommended by the joint committee report for the number of bacteria per milliliter.

2. High-free residual chlorination is effective in maintaining a low bacteria count in both indoor and outdoor swimming pools.

3. High-free residual chlorination is superior to marginal chlorination for bactericidal treatment of swimming pool water.

4. The minimum value of 0.7 p.p.m. which has been suggested by the joint committee for a chloramine residual in swimming pools was insufficient to produce results, under conditions of the study, which met the bacteriological standards of the joint committee.

5. Several common types of bacteria are capable of surviving high-free residual chlorine, in small numbers, for at least a limited time. Streptococcal bacteria in swimming pools are more resistant to chlorine than are coliform bacteria.

6. High-free residual chlorination is capable of keeping swimming pool water free of coliform bacteria while occupied by bathers.

Other observations of these disinfectants, reported by Mood (*17*), have to do with the sometimes irritating effects of chlorine. He states that high-free residual chlorination of swimming pool water reduces the amount of irritation to the eyes of swimmers, as compared with marginal chlorination. He found that optimum conditions of the swimming pool, insofar as minimal irritation to the eyes of swimmers is concerned, are found in waters with a pH of 8.0 to 8.9 and a residual chlorine level of 1.0 to 3.99 p.p.m., with the principal portion of the fraction as free residual chlorine. He cautions, however, that high-free chlorination cannot be applied to every pool. He believes this type of treatment to be most suitable for waters that are recirculated and filtered 24 hours a day.

Burgess, Burns, and Tidy (*18*) investigated methods of improving the quality of water in less modern pools, which may have been designed without regard to presently accepted principles of swimming pool construction. Among other things, they studied the reason for the loss of chlorine residual, the relationship between bacteriological conditions and chlorine

residuals, various means of increasing chlorine input and, thus, chlorine residuals and the significance of albuminoid nitrogen in relation to clarity and bacterial purity.

Sunlight was considered the factor causing the greatest loss of free chlorine in an outdoor pool. Original water quality and bather loads were also significant. Data are presented showing that the disappearance of free chlorine quickly results in an increase of the agar count, followed by the presence of viable coliform organisms. Alteration of the position of the chlorine application was found effective in increasing chlorine input with existing equipment. Changing the point of chlorine application from the filter outlet, where the pressure is in the region of 5 to 10 pounds per square inch, to the suction side of the circulating pump, where the pressure difference increases, permits a greater input. The interpretation given to the data on albuminoid nitrogen indicates that it is possible to have a practically sterile water containing a high albuminoid content. However, when such a water is so polluted, the time taken to kill any bacteria which may be introduced will be increased according to the amount and type of organic pollution present.

Except for chlorine and bromine, no disinfectants for swimming pool waters have been introduced that approach the desired qualities recommended by Klassen and Sieg. At various times, ozone, ultraviolet light, chlorine dioxide, quaternary ammonium compounds, and silver have been suggested. All of these are effective in their bactericidal action but present practical difficulties in maintaining or determining an effective residual, and it is doubtful that they can compete with chlorine on an economic basis.

Swimming Pool Filters

One other relatively new item concerned with swimming pools is germane to the subject of water quality. This concerns the use of diatomite filters. A very recent article on the principles and operation of this type of filter, as compared with other filters, appeared in *Waterworks Engineering* (*19*). Perkins (*20*) made a comparison of different types of filters for swimming pools and concluded that, for efficiency and economy of operation, the vacuum-type septum filter is as good as any filter available. Although diatomaceous earth is usually foremost in mind when referring to septum filters, recently other types of media have been tried for filter purposes (*20*).

Some of the advantages of using diatomite filters may be listed as follows:

1. If the filters are not overloaded, coagulants are not needed.
2. Filtration rates may be varied as much as 100 percent or more without reducing the clarity of the effluent.
3. Efficiency of filtration is not reduced by excessive head losses.
4. Diatomite filters are compact units, serving to advantage where space is at a premium.

The results of 7 years of experience in the District of Columbia in using several types of commercial diatomaceous-earth filter units for filtration of swimming pool waters are discussed by Levin and Cary (*21*). According to the authors, general considerations indicated that filters with which they had experience were liable to corrosion because of galvanic action. It was stressed that minimum use should be made of dissimilar metals in the manufacture of the filter. The other important observation revealed that inadequate backwashing was evident. It was reported that experimental tests conducted by the Army indicate that air-bump backwashing and use of mechanical air compressors may clean the filter units satisfactorily, if instantaneous rates of 100 to 200 times maximum filter rates are used. The authors recommend that units without special backwash facilities be disassembled and cleaned manually at least once each year.

The present status with regard to the use of diatomaceous-earth filters was summed up by Kiker (*22*) at the Sixth Florida Public Health Engineering Conference. He stated that these installations are likely to increase in number in the future as they have in the recent past. Their initial cost is less than that of pressure sand filters, and they require much less space. They can produce an effluent at least as good as that from sand filters. The cost of operating septum filters is comparable to the cost of operating pressure sand filters. But, as compared to pressure filters, they are still in a relatively early stage of development. Under the circum-

stances, Kiker believes that rapid sand gravity or pressure filters are still to be preferred for most permanent filtration installations where adequate space is available. Kiker indicates his comparative evaluation is subject to change with further improvements in septum filters and with increasing operational experience.

Summary

Since the report of the joint committee (*2*), much has been written on the interpretation of bathing water quality and its relation to public health. Research, investigations, and experiences have been reported that indicate a need to refine old procedures or substitute new ones, in order to provide a safe quality of bathing water.

It is evident also that no mutually acceptable opinion exists on what constitutes minimum bacteriological standards for natural bathing areas. There is general agreement, however, that the results of bacteriological and chemical analyses and sanitary surveys should be considered in judging the acceptability of any particular area for bathing purposes. Application of bacterial guides to natural bathing areas must depend upon such factors as availability of other, more suitable places. This will vary according to geographic area.

As yet, no substitute for the coliform group, as an indicator of pollution in bathing water, has received general approval. The consensus still indicates that one is needed.

It appears that chlorine and bromine remain the disinfectants of choice. Other suggested agents, though effective in their bactericidal action, do not come as close as chlorine and bromine toward meeting the requirements of the "ideal" disinfectant.

Though diatomite filters are gaining in popularity, there are those who feel that these filters still need to pass the test of time before they can be given full acceptance on a par with other proved types of swimming pool filters.

The public and public health officials are rightfully concerned about the hazards of bathing in contaminated waters; however, present epidemiological evidence does not offer a clearcut picture of the actual danger of disease transmission through bathing waters. Nevertheless, there is sufficient correlation of data between bathing water quality and swimmers' complaints to warrant continued regulation and supervision by health authorities pending further accumulation of knowledge through additional research and experience.

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Practical Methods for Control Of Algae and Water Weeds

By A. F. BARTSCH, Ph.D.

EVERY YEAR, increasing energy is being directed toward the control of excessive growths of algae and water weeds. Specific reasons for control vary, but in each case aquatic nuisance control is an attempt to protect or restore water uses that are considered valuable locally.

Algae and water weeds are not necessarily bad, not always a nuisance. They have an important place in the biological world in which we live. As normal year-round inhabitants of water, they help to determine its fertility, its ability to produce fish, support waterfowl and fur animals, and cleanse itself of pollution. From a historical viewpoint, algae and water weeds may signify a stage of developmental progress from lake to bog and finally to dry land.

But when algae are readily seen or smelled, when water weeds cover the bottom or float on the surface, or when either or both interfere with an important water use, demands for corrective action are made. Just as there is often a lack of agreement on the relative importance of various water uses, so also controversies may arise as to the need for control and the means by which it is to be accomplished (*1*).

Methodology varies with the nature of the problem, the geographic area, the existence of restrictive legislation, the equipment at hand, and the knowledge and experience of those doing the work. It is important to recognize that poorly conceived plans and haphazard execution may be more damaging than the aquatic growths they are designed to eliminate. Principally for this reason, and because no concise set of instructions is generally available, the following pages will describe various methods that have been used and important precautions that determine their safety and effectiveness.

All phases of algal and water weed control cannot be covered adequately in a single paper. Extensive literature already exists on control of algal tastes and odors in water supply (*2*). The "red tide," mussel poisoning, and the many commercial algicides used principally in swimming pools are outside the scope of this paper. Because methods and materials for controlling emergent and floating-leaf water plants are

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quite similar to those used on terrestrial plants, and because information on this subject is readily available (*2*), the section discussing methodology for water weed control is restricted to submerged plants only.

Characteristics of Algae

The word "algae" has not yet become popular in social conversation, but there is good reason to believe that algae will be much better known to future generations. They have two characteristics that hold promise of giving them great distinction. First, they can be grown intensively on a large scale to produce crops of potential high-protein food and raw materials for synthetic chemicals, fats, hormones, alcohol, and drugs (*3*). Second, sewage can be used as the culture medium, becoming stabilized in the process and contributing nutrients that heretofore have been dumped into surface waters and lost to productive use (*4–9*). Research already completed reveals the amazing possibility that over an area of less than a million acres enough algae could be grown to supply half the food protein needs of the present world population. Thus, this practice of algalculture may well contribute to the solution of two pressing problems—food supply and waste disposal.

In common with cultivated algae, those growing unattended in natural bodies of water have the same ability to convert inorganic materials into energy-bearing foods. For this reason they are important as the starting point of a food progression that ends with fishery products. Fish may feed directly upon these minute plants or may get them indirectly by eating minnows that ate insect larvae that ate waterfleas that ate algae. In either case, fishery products are principally algae, once or more removed.

Nearly all algal difficulties are caused by the ability of algae to grow rapidly and produce dense populations called blooms. Many of the details of how, why, and when algae take off on a growth rampage are not known. It is known, however, that they must have nutrients, ample light, and suitable temperature range.

Water everywhere is a potential culture medium for at least some kinds of algae. Surface

A midwestern lake during an algal bloom with windrows of algae along the shoreline.

waters naturally contain all the kinds of nutrient elements needed for growth, some of which are used only in trace quantities. Waters having more nutrients grow bigger crops of algae, just as fertile farmland grows more grain per acre than less fertile land (*10, 11*). Of the various elements necessary to growth, nitrogen and phosphorus have attracted most attention because algal blooms are most frequent and objectionable in hard-water lakes containing abundant supplies of these two elements. In addition, there is reason to believe that exhaustion of phosphorus through growth uptake may function in limiting further algal growth (*12*).

Variations in light intensity, temperature, availability of nutrients, and other changes that come with changing seasons somehow interact to stimulate algae into seasonal spurts of growth. The springtime appearance of diatoms, the summer and fall appearance of blue-green algae, and the reappearance of diatoms in fall and winter are well known to many water works operators.

Excessive algae cause damage in a number of different ways. The seasonal havoc they cause in water works by interfering with filtration is only too well known. Rapid filters which might ordinarily operate for 75 to 100 hours between washes sometimes have filter runs reduced to 2 hours or less. Diatoms such as *Synedra*, *Asterionella*, and *Melosira* are chiefly responsible. Disagreeable tastes and odors frequently accompany excessive algae, apparently as a result

of compounds released directly from the algal cells or produced by actinomycetes associated with them (*13*, *14*).

Water works operators have devised many ingenious methods for combating their particular algal problems and removing tastes and odors. This phase of the algal control problem is covered thoroughly in the literature (*2*, *15*).

In many fertile lakes, blooms of algae, especially blue-greens, become so profuse that the water takes on a pea-soup consistency and color. Odors, which at first may be grassy, haylike, and not particularly unpleasant, become especially objectionable when the algae decay. Floating windrows of algae sometimes are compacted into a scum so solid that turtles and birds can walk on it. Lakes in this condition have no utility for bathing, boating, fishing, or any other form of recreation. Before this point has been reached, property owners and resort patrons already have left for more pleasant surroundings.

Algal decay in summer sometimes depletes dissolved oxygen resources so that fish die of suffocation (*16*). In frozen, snow-covered lakes, respiratory utilization of oxygen by algae themselves may bring about the same end result which is commonly known as "winterkill." Some kinds of algae can kill fish and other animals directly through production of poisons. Since 1878, reports of animal poisoning by toxic algae have come from every continent in the world. The victims include domestic animals: cattle, sheep, horses, turkeys, geese, and dogs; and wild birds, mammals, and fish (*2*). The "red tide" off Florida, caused by pigmented free-swimming algalike organisms, and mussel poisoning along the Pacific coast are related phenomena.

These damages demonstrate clearly that algal control is necessary and justifiable under certain conditions. Algae may be controlled either by limiting their unrestricted growth or by killing existing algae. Local circumstances determine which procedure is more desirable.

Control by Growth Limitation

When feasible, nuisance growths of algae can be limited or prevented by limiting the area of shallow water in reservoirs, by maintaining high water levels, and by limiting incoming nutrients from soil erosion, irrigation return flows, sewage and treatment plant effluents, certain industries, and other sources. This type of approach is sometimes called biological or ecological control.

It has been pointed out that the lakes at Madison, Wis., are notorious for several reasons (*12*): because Longfellow once wrote a complimentary poem about them; because of the extremely objectionable algal blooms which have infested the lower lakes of the chain; and because of the large-scale use of copper sulfate to control blooms in three of the lakes having a total area of 13.5 square miles. To these should be added now a fourth distinction: the current attempt to alleviate the algal difficulties by diversion of effluents from a secondary sewage treatment plant around the lakes to the Yahara River below. This activity, costing several million dollars, is motivated by State legislation of which the validity has been upheld by the Wisconsin State Supreme Court.

Concurrently, research has developed methods for stripping effluents of nitrogen and, more particularly, phosphorus. Plant scale tests of phosphorus removal with lime have been made in Minnesota and Wisconsin (*17–19*); other phosphorus removal tests are under way in Connecticut. Effort continues in learning to understand better the various complex factors that determine how lakes respond when fertilized by effluents (*20*). As growing population contributes greater quantities of phosphorus to water and as the use of phosphorus-bearing detergents increases, it can be expected that phosphorus removal will be considered more widely as an algal control procedure.

Complete exclusion of light to prevent algal growth is exemplified in the covering of water storage tanks and basins. Partial exclusion of light by induced turbidity has had limited application and this only in the water works field intermittently since 1933. For this purpose, activated carbon is applied to open coagulation and settling basins by bag-dragging, injecting, or pumping to produce a so-called carbon "black-out." Dosage rates of 1 or 2 parts per million once or twice daily on sunny days have proved satisfactory.

Control by Algicides

Although new commercial algicides continue to appear on the market, practically all large-scale projects in recreational waters involve use of copper sulfate. Experience with this compound dates from 1890 in Europe and from 1904 in America, and its merits and shortcomings are fairly well known. In spite of this, such important factors as the mechanism by which it kills algae, determination of exact necessary dosages, long-term effects upon lake ecology, and inducement of algal tolerance are either unknown or controversial.

Temperature, light, and alkalinity determine the amount of copper sulfate that must be added to water to produce a killing concentration that will persist for a sufficient contact period. Alkalinity is particularly important because of the completeness and rapidity with which soluble copper can be precipitated as a copper carbonate. Undoubtedly, this reaction accounts for much of the variability of success when published dosages for different species are followed. Three developments represent attempts to fit the dosage more accurately to the chemical nature of the water.

One of these is the use of the citrate salt to avoid rapid copper precipitation (*21*). A mechanical mixture of sodium citrate and copper sulfate, now on the market, is used chiefly in industrial plants. It is reported to be successful.

A second approach is the development of a "copper sulfate demand test" to indicate the optimum dosage for the algae in a given water (*22*, *23*). The test has been used successfully by some but not all persons. There appears at present to be no reasonable chemical explanation for the test reaction.

The third approach is utilization of simple arbitrary dosage rates related to alkalinity. The following have been used successfully in various midwestern lakes for 15 years:

Methyl orange alkalinity<50 p.p.m.=0.3 p.p.m. $CuSO_4.5H_2O$ in total volume of water (0.9 pound per acre-foot).

Methyl orange alkalinity>50 p.p.m.=a rate equal to 2 p.p.m. $CuSO_4.5H_2O$ in surface foot of water only (5.4 pounds per acre).

Material cost at these dosage rates is approximately $1.80 per acre.

Courtesy of K. M. Mackenthun, Wisconsin Committee on Water Pollution.

A fish kill caused by blue-green algae.

Regardless of the equipment used, the principal requirement in treatment is rapid and uniform distribution of the algicide. This is an important requirement, whether the body of water is treated in its surface entirety or only along a marginal zone. Copper sulfate has been applied in many different ways—by bag-dragging, power blowers, aircraft, dry feeders, solution boxes, drippers, sprayers, and by placing crystals on ice (*2*). Spray equipment has been widely used because it meets the rapid distribution requirement quite satisfactorily and

usually can be assembled from equipment at hand.

Water supply for the spray unit (see diagram) is pumped from the lake through intake I, and the main volume of flow goes out through the spray nozzle, which is hand-operated. By manipulating valve V_2, water can be directed onto crystals at C. If sufficient material is maintained in the bag M, a saturated solution will be obtained. This solution is introduced into the system through line S, and the quantity regulated with plug valve V_1. Mixing occurs in the pump.

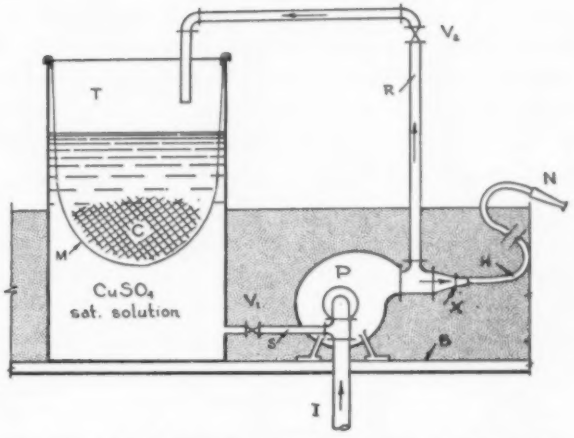
In operation, saturated copper sulfate solution is bled into the pumping system at a rate determined by width of spray lane, speed of boat, and temperature of the water. The table shows the gallons per minute that will yield 1 p.p.m. of copper sulfate for 1-foot depth under the conditions specified.

A meter to measure flow in line S would be desirable. Less accurate but similar results can be obtained by calibrating valve V_2 and then adjusting valve V_1 to maintain a constant level in the solution tank.

During treatment, it is advantageous to spray along successive parallel lanes working from the shoreline outward. In lakes with appreciable alkalinity, rapid formation of copper carbonate gives the treated water a slight milky appearance. This can be used as a guide to avoid additional spraying in areas already covered. Sighting points on shore can be used when treating less alkaline lakes in which a similar color change does not occur.

To persons experienced in algal control, development of a peculiar and characteristic odor indicates that algae have been affected by treatment. Origin of the odor is not definitely known, but it perhaps is caused by aromatic substances released from cells in the presence of copper. Simultaneously, the algae become faded, and mats of filamentous algae become frothy from trapped gas bubbles. These changes occur within 10 to 20 minutes. Within a day or two the algae largely disappear, and the water is usable again. Duration of relief depends upon a number of factors, varies with different bodies of water, and cannot be predicted exactly. When small lakes are treated in their entirety, one treatment per season usually suffices. If shoreline zones only are treated, several applications usually are required.

Diagrammatic sketch of copper sulfate applicator.



KEY: I—Water intake line. S—Copper sulfate solution line. P—Pump. H—Applicator hose line. N—Spray nozzle. X—Location of injector, if used, line S being directly connected at this point, in that event. R—Recirculation line. T—Copper sulfate solution tank. C—Copper sulfate crystals. M—Mesh or burlap bag. V_1 and V_2—Plug valves. B—Boat hull.

Copper sulfate has properties that make it much less than an ideal algicide. Among them are the following: (*a*) Like other heavy metals, copper in sufficient concentration has the ability to poison fish and other aquatic life; (*b*) when precipitated, it can accumulate in lakes; and (*c*) it is corrosive to equipment and paint. Because of these properties a number of important precautions should be noted. Avoid spraying on or near minnow traps or live boxes because the momentary high concentration may be sufficient to cause fatalities. The screened intake to the pump should be kept clean to avoid pumping excessive volumes from the solution tank. In the event a weed-clogged propeller, sheared pin, engine failure, or other difficulty stops the boat, close valve V_1 immediately to prevent overdosing. Avoid spraying on painted buildings, boats, and piers that will be stained by the chemical. Finally, if the pump and piping are not fabricated of copper-resistant materials, flush thoroughly by pumping lake water through them before stopping operations, even for a temporary period.

Field and laboratory studies have shown that fish are not killed by copper at concentrations

normally used for algal control, that the fishing and fish yields of lakes treated as long as 26 years have not deteriorated, and that accumulations of copper in the bottom of the most-treated lake in the country, Lake Monona, Madison, Wis., have not destroyed its ability to produce and support bottom-dwelling organisms that serve as fish food (*24–28*).

In spite of this, the use of copper sulfate is not foolproof, and the margin between a safe and satisfactory treatment and one that may destroy fish or cause other harm sometimes is not very great. For this reason, chemical treatment activities should be entrusted only to technically trained persons fully familiar with potential hazards and able to take the necessary precautions. Consideration of these points has led either to specific legislation or to State supervision of chemical treatment in such States as Wisconsin, Minnesota, and Michigan.

The deficiencies of copper sulfate have also stimulated a systematic search for a more desirable algicide. Preliminary tests with one compound (2,3-dichloronaphthoquinone) show that it holds promise as a more selective algicide for blue-green algae, which most commonly cause nuisance blooms in lakes (*29*). It apparently has no immediate toxicity to other organisms and does not accumulate. It has not yet been used on a large scale. The algicidal properties of certain antibiotics are under study also (*30*).

Gallons of saturated solution of $CuSO_4$ required per minute to give 1 p.p.m. $CuSO_4$ (for depth of 1 foot)

Speed of boat (miles per hour)	60-foot width of spray		
	15° C.	20° C.	25° C.
1	0.21	0.19	0.17
2	.42	.38	.35
3	.62	.57	.52
4	.83	.76	.70
6	1.03	.95	.87
5	1.24	1.14	1.04
	80-foot width of spray		
1	0.28	0.25	0.23
2	.56	.51	.47
3	.83	.76	.69
4	1.11	1.01	.93
5	1.37	1.27	1.16
6	1.65	1.52	1.39

Characteristics of Water Weeds

Like algae, water weeds have many values when the crop is not excessive. In addition to contributing to the natural appearance of bodies of water, vegetation serves as food for many animals from insect larvae to muskrats, beaver, deer, moose, and waterfowl; as cover and breeding places for fish; as a stimulator of natural purification; and potentially as mulch and food for farm animals.

On the other hand, excessive vegetation interferes with bathing and other recreation, fishing and fishery management, pleasure boating, and commercial navigation. It limits the flow in irrigation canals and drains, depreciates waterfront property, contributes to winterkill of fish, and supports mosquito breeding. These are the reasons why waterfront property owners and improvement associations seek methods that will give relief.

Growth of water weeds is influenced by light penetration, availability of nutrients, and temperature, in much the same ways as is algal growth. In addition, some plants are dependent on suitable bottom material and depth of water. Although most plants propagate by means of seeds, many have accessory propagation abilities by rootstocks, tubers, winter buds, and plant fragments. These facts suggest physical control methods that may be used and explain some of the difficulties that arise.

Physical Control of Water Weeds

Physical control of water weeds includes both mechanical and nonmechanical methods. Many mechanical methods and equipment, such as hand raking, dragging chains, pulling cables, underwater saws, power mowers, a puller and baler, and a cutter and baler, have been used with variable success. Notable disadvantages of some of these methods are oxygen depletion from decaying weeds, development of stockier weed growths, and rooting of cut fragments. These methods do, however, offer the advantage of quick action and are suitable for opening isolated channels.

Two newly developed machines (one developed by a private individual at Hartland, Wis., and one developed by the University of Wisconsin) that automatically remove the plant mass after either pulling or cutting have several important advantages. They eliminate many of the disadvantages of simple cutting, such as oxygen depletion and attendant fish kills, odors of decay, and the nuisance of wind-driven windrows of rotting weeds concentrated along shorelines. They also remove nutrients in the form of cut weeds which eventually may limit both nutrients and weed growth.

Of the many nonmechanical methods that have been used, two are sufficiently novel to be of interest. Both represent attempts to produce environmental conditions that limit photosynthesis. In one case, the water is converted into weak ink by adding a black dye called nigrosine (*31*). The method thus far has been only partially successful. The dye is nontoxic to fish but has the disadvantage of making the water unattractive until natural forces cause the dye to fade. In the other case, light penetration is decreased by heavy blooms of algae that are stimulated by intentional addition of fertilizer (*32*). Although the method has been used with some success, the stimulated blooms of algae may themselves be equally objectionable. When used in impoundments which can be at least partially drawn down, the added nutrients can be drained away eventually.

Chemical Control of Water Weeds

During recent years, a large variety of chemicals have been used for control of submerged aquatic plants. Among them are hydrocarbons such as orthodichlorobenzene, trichlorbenzol, dichlorbenzol, and naphtha; hormone weed killers such as 2,4-D and 2,4,5-T; and other compounds such as sodium chlorate, ammonium sulfamate, copper sulfate, and sodium arsenite (*33*). None can be considered an ideal aquatic herbicide for general use.

The chlorinated hydrocarbons and naphtha, while effective under proper conditions, are so highly toxic that they will kill fish and their food before controlling vegetation. Ammonium sulfamate and the 2,4-D's are too expensive for use on submerged plants. Sodium chlorate is suitable for muskgrass but will kill fish and fish food at weed-killing dosages.

Sodium arsenite remains as one of the cheapest, safest, and most effective chemicals for use in recreational areas. So far as published records go, it was first used for this purpose 30 years ago in the Madison, Wis., lakes and has since been adopted for use in fishery management. It is now widely used, especially in the midwest. Because of its toxicity, proposals to use it in water supply reservoirs should be considered with extreme care.

Mainly on the basis of field experience, effective dosages under various conditions are quite well known. Although concentrations as low as 1 p.p.m. (white arsenic equivalent) will affect plants after a sufficiently long exposure period, application rates in practice must compensate for arsenic losses by diffusion, wave action, and absorption by vegetation and bottom mud. The following rates are commonly used (*34*):

(*a*) Ponds and lakes treated in entirety=5 p.p.m. (as As_2O_3); (*b*) Shoreline areas:

1. Minimum dimensions of area suitable for treatment = 200 ft. x 200 ft. unless a slough or bay, with minimum area of 4,000 sq. ft.

2. Protected bays and protected shoreline areas, maximum average depth 8 ft.=7.5 p.p.m.

3. Unprotected areas, maximum average depth 8 ft.=10 p.p.m.

4. Treatment of areas outside these limits as well as isolated patches—difficult, unduly costly, and not dependable.

Commercial sodium arsenite is available in three forms—a dry powder, a solution containing 4 lb. of As_2O_3 per gallon, and another containing 9.6 lb. per gallon. The 4-lb. preparation is used most commonly. Material requirements can be determined easily from the fact that 2.7 lb. per acre-foot=1 p.p.m.=0.67 gallon of 4-lb. solution. Material costs range from about $2 to $4 per acre-foot. (An "acre-foot" of water is the quantity of water in an acre of water 1 foot in depth, or the equivalent of 43,560 cubic feet of water.)

For small areas, the chemical can be applied underwater by gravity feed lines draining a solution tank. Spraying equipment similar to that used for algal control is suitable for large-scale operations. The total areas to be treated should be delineated into subareas of such size that they require a quantity of material equal

to one-half the capacity of the solution tank. This permits initial dilution to a 2-lb. solution and allows more accurate distribution. Treatment should be from the shoreline outward, first along lanes of travel parallel to the shore, and then at right angles to it so as to crisscross the area in two directions. Attempt should be made to regulate dosage relative to depth.

Generally, 5 to 10 days are required for death and collapse of plants. Seeds are not appreciably affected. Dead plants turn brown, generally sink to the bottom and decompose, but with rough water some may be torn loose and float to the surface. Such floating vegetation should be removed from the water to avoid development of nuisance conditions. The duration of relief following treatment is determined by a number of factors. Notable are the relative size of the treated area to the total area of weed growth and, within it, the effectiveness of kill. In most cases, treatment must be made during two or three successive seasons to obtain relief of several years' duration.

The toxicity of arsenic and causticity of the solution make necessary a number of important precautions. Cattle and other grazing animals should be excluded from the treated area for at least 3 days following treatment. Care should be exercised to avoid spilling or spraying the solution on flowers, shrubbery, trees, or other vegetation—especially where grazing may later occur. Water should not be used for bathing or stock water for at least 3 days. Rubber gloves and protective cream or a face mask should be worn by the operator, and direction of boat travel should be such as to avoid wind-blown spray that will cause skin burns.

Field and laboratory tests show that there is a fairly wide margin of safety for fish and fish foods when using arsenic. In laboratory aquariums, critical concentrations for various kinds of fish over a 10-day period range upward from about 10 p.p.m. As_2O_3. Fish food animals vary widely in tolerance; mortality rates for chironomids, mayfly nymphs, and freshwater shrimp may be high at 2.5 to 4.0 p.p.m., whereas damselfly and dragonfly nymphs, sow bugs, and water mites survive concentrations of 10.5 to 21.0 p.p.m. (*3*4*).

Hazards to aquatic organisms during and after treatment are less serious than the laboratory data suggest. Most fish and some fish food animals are repelled by the chemical and move into untreated water. Diffusion, wave action, and absorption by the vegetation and bottom mud progressively reduce the concentration. Hazards are greatest when large masses of decaying vegetation deplete dissolved oxygen. This can be avoided by initiating treatment when the plants are young and growing vigorously or by temporarily leaving areas untreated if control procedures are not initiated before the vegetation becomes dense.

The history of water weed and algal control, although not well recorded, is marked occasionally by instances of fish destruction. In practically every case they resulted from excessive enthusiasm among untrained operators who apparently felt that if 1 p.p.m. will control algae, 10 p.p.m. should do it 10 times as well. Such unfortunate occurrences reemphasize the importance of limiting control activities to trained technicians only.

Control of aquatic plants is becoming a recognized management tool in the field of water conservation. Frequently it is necessary, if acceptable potable water is to reach the consumer. In other waters, continued recreation, fishery management, navigation, and other water uses that provide pleasure and profit are dependent on it.

Presently available algicides and aquatic herbicides leave much to be desired. Ideal preparations for these purposes should be safe, selective, and economical. The search for them continues, and there is real promise that cleaner lakes can be a reality.

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Long-Term Trend and Economic Factors Of Paresis in the United States

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ONE of the chief aims of public health measures for the control of syphilis is the prevention of the disabling complications of late syphilis. The reasons for this objective are the human suffering and social disintegration caused by these late manifestations; the high costs to individuals, private organizations, and taxpayers for the care of those disabled and their families; and the losses which society sustains in productive years of life of persons disabled or dying prematurely from syphilis. These costs are known to be high. To mention only a few examples, the maintenance in public institutions of patients with syphilitic psychoses cost an estimated $40,295,000 in 1951; maintenance and assistance to the syphilitic blind was estimated in 1951 to cost $12,500,000; years of life expectancy lost because of premature death from syphilis was estimated at 142,000 man-years in 1950 (*1*).

Long-Term Trends

While the present cost in human life and dollars seems clear, little has been published to indicate the long-term trends of these costs. This has been due primarily to a scarcity of data. Paresis or general paralysis of the insane, however, is one late sequela of syphilis for which there are sufficient data to indicate the long-term trend of incidence and loss of life and to suggest the possible savings or reductions in cost in man-years of life and personal income losses which may accrue through reducing the incidence of, and mortality from, the late complications of syphilis.

An analysis by Iskrant of the economic cost of paresis in the year 1940 was published in 1945 (*2*). Iskrant's study indicated that the annual loss of working years of life from this cause was 75,729 man-years and 23,645 woman-years. Income loss amounted to $112 million for men. The cost of maintaining paretic patients in mental institutions was $11.3 million. Because of great changes in the national economy and a lack of comparable data for recent years, no direct comparisons will be made between these estimates and recent costs. By other means, however, the reductions in costs or the economic savings accrued will be indicated.

Paresis death rates are available for some States since 1900, the year in which the Bureau of the Census began the annual collection of mortality data (*3*, *4*). The paresis mortality rates for the expanding registration area are shown in table 1. The addition of States as they entered the death registration area had little effect on the trend of paresis death rates. A measure of this effect can be gained from

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figure 1, which shows the comparative trends of paresis mortality rates for the registration States of 1900 and for the expanding registration area for the entire period, 1900 to 1951. The expanding registration area has included all States since 1933. Admission of several States between 1905 and 1908 lowered the paresis death rate in the expanding registration area about 1 to 1.5 per 100,000 population. The difference has gradually diminished over the years, and the rates now are in very close agreement. The differences in the rates during this early period may be attributed principally to differences in the age distribution of the populations of the two registration areas (*5*).

The definition of paresis in the International Lists of Causes of Death has been fairly uniform over the entire period of national mortality statistics. Consequently, the trend of paresis death rates has been little affected by the decennial revisions of the lists of causes of death. One possible exception is the sixth revision, which became effective in 1949. In this revision the number of deaths classified as due to syphilis is reduced by about 26 percent compared to the number so classified under the fifth revision. Preliminary data indicate a sizable reduction in paresis mortality as well as in total syphilis. The main change affecting reported paresis mortality resulted from the abandonment of the earlier system of fixed priorities for assigning the underlying cause of death from among several causes listed on death certificates and the placing of all responsibility for selection of the underlying cause of death on the certifying physician. Since sufficient data are not yet available for adjusting numbers of paresis deaths to compensate for the lack of comparability between the fifth and sixth revisions, the rates presented in this paper are based on deaths tabulated according to the revision of the international lists in effect in the year in which the deaths occurred.

Table 1. Paresis mortality rates per 100,000 population, expanding registration area, continental United States, 1900–1951

Year	Mortality rate	Year	Mortality rate	Year	Mortality rate
1900	7.4	1918	7.4	1936	3.5
1901	7.3	1919	5.8	1937	3.2
1902	7.8	1920	5.8	1938	3.5
1903	7.4	1921	6.3	1939	3.4
1904	7.8	1922	6.6	1940	3.4
1905	8.0	1923	6.6	1941	3.2
1906	7.3	1924	6.3	1942	3.4
1907	5.1	1925	5.8	1943	3.5
1908	5.2	1926	5.6	1944	3.5
1909	5.2	1927	5.0	1945	3.3
1910	5.6	1928	4.7	1946	2.9
1911	6.8	1929	4.3	1947	2.5
1912	6.8	1930	4.1	1948	2.0
1913	7.0	1931	3.9	1949	1.2
1914	7.2	1932	3.8	1950	0.9
1915	7.5	1933	3.6	1951	0.7
1916	7.3	1934	3.8		
1917	7.2	1935	3.6		

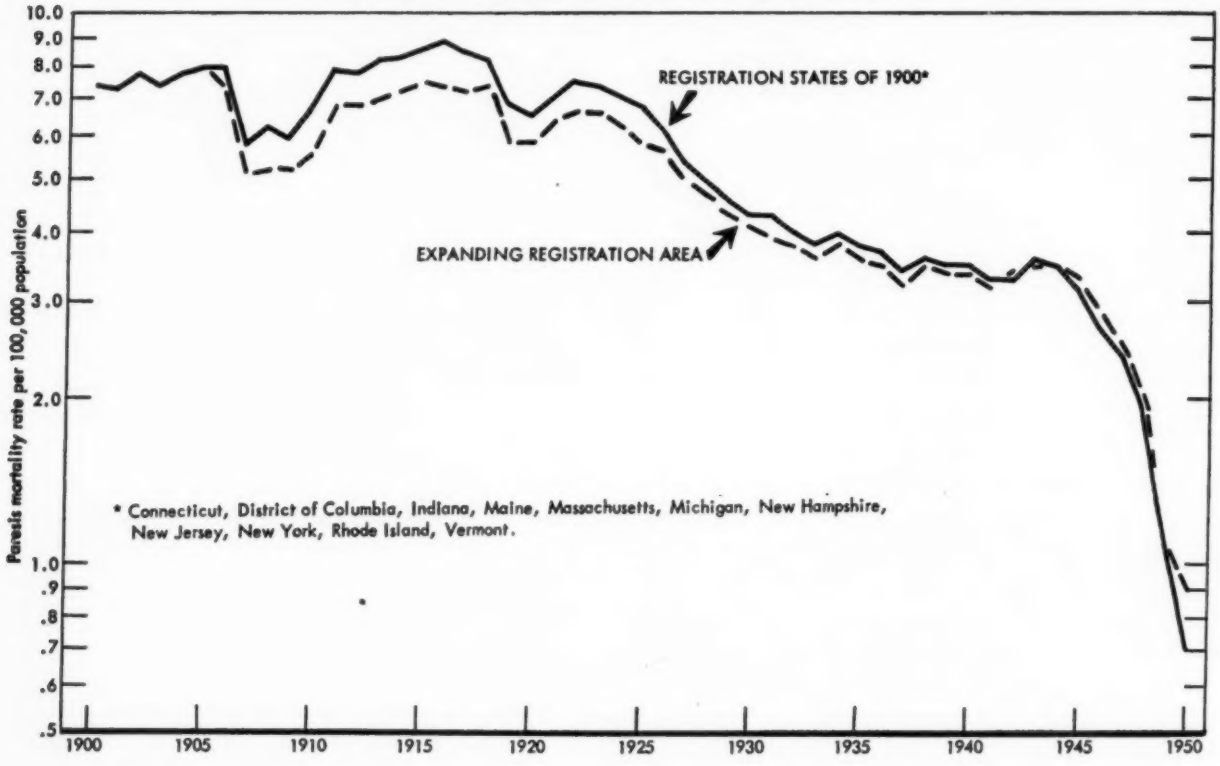
For purposes of this study, paresis death rates have been divided into three time periods (fig. 2). The first period includes the years 1900 to 1923, a period of practically no preventive effort to control syphilis and of ineffective therapy. The second period, 1923 to 1938, is one of little preventive control, but a period during which malaria and other fever therapy were in general use. The third period covers the years 1938 to 1951, the period of the national syphilis control program.

1900–1923

The initial period, from 1900 to 1923, is characterized by a level mortality trend, with an average of 6.7 deaths per 100,000 population (geometric mean). There are two sharp dips in the death rates in the years 1907 to 1910 and 1919 to 1921. There is apparently no logical explanation for the deviations from 1907 to 1910. The 1919 to 1921 trough is similar to a dip which occurred in the mortality for all chronic diseases and apparently is associated with the influenza epidemic of that time (*6*). The same dips may be observed in the trend for the registration States of 1900, indicating that this phenomenon is not associated with the expansion of the registration area. A semilogarithmic curve fitted to the rates for the years 1900 to 1923 has a slope which does not differ significantly from zero (at the level $P=0.95$).

Malaria therapy for paresis, developed in Europe by von Jauregg, was introduced into the United States about 1923. This and other types of fever therapy quickly gained acceptance and their use increased rapidly. The Committee on Evaluation of Fever in the Treatment

Figure 1. Paresis mortality rates per 100,000 population for the registration States of 1900 and the expanding registration area, 1900–1950.



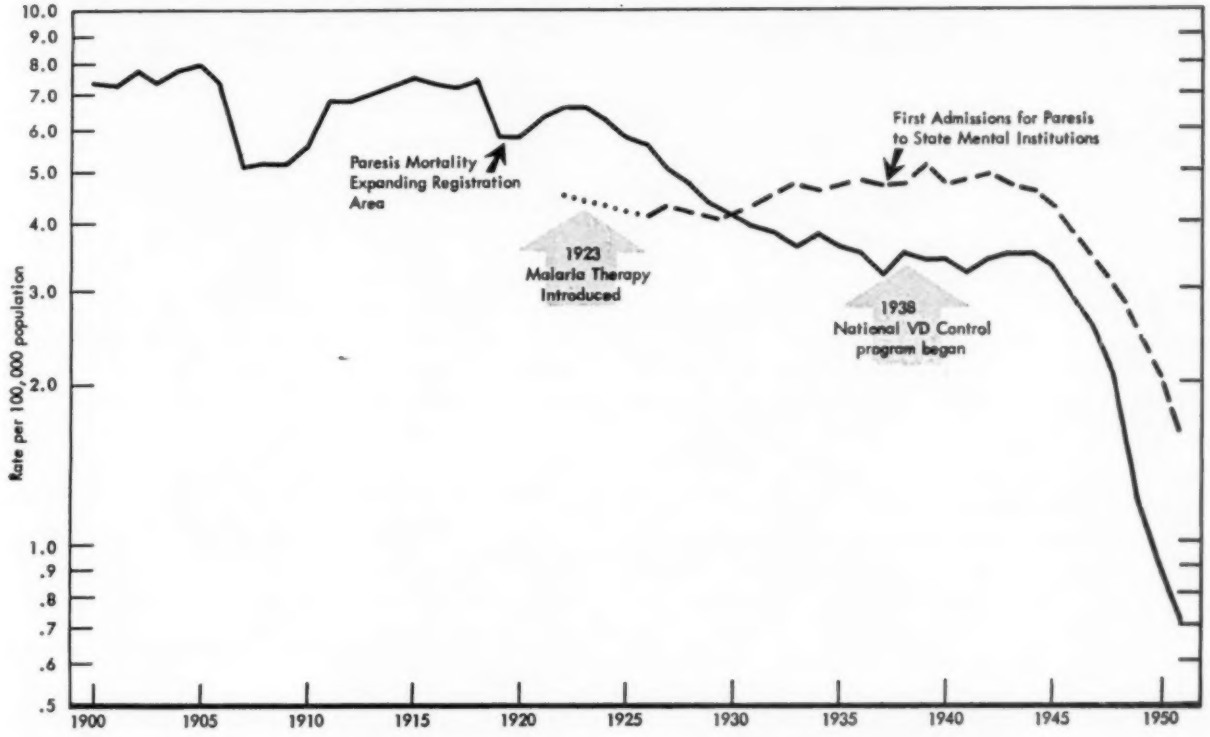
of Paresis in 1940 reported the following results on 1,420 patients (*7*): "The chances of clinical remission in patients with mild paresis were approximately 1 out of 2; in patients with intermediate paresis, 1 out of 4; and in patients with severe paresis, 1 to 10 out of 100." Clinical remission was defined as response sufficient to enable the patient to return to his normal socioeconomic status. The crude fatality rate within 3 months of treatment was 13 percent with malaria and 8 percent with artificial fever (*7*). Patients having paresis complicated by cardiovascular disease or other serious physical conditions could not be treated with fever because of the high mortality risk (*8*).

1923–1938

Fever therapy evidently was successful in reducing the mortality from paresis. Paresis death rates from 1923 to 1938 show a general downward trend with a tendency to level off after 1936 (fig. 2). A semilogarithmic curve fitted to the death rates for the 1923 to 1938 period indicates a marked downward slope. A decline of this magnitude may be expected to occur by chance less than once in 1,000 times under similar circumstances. The geometric mean value of the rates for these years is 4.3 compared to 6.7 for the previous period.

It is important to note that the reduction in mortality from paresis in this second period was the result of the treatment of patients and not the result of a reduction in the incidence of paresis. Some indication of the incidence picture can be gained from data on admissions to mental institutions (*9*). The rate of first admissions for paresis to State mental institutions increased from 4.1 in 1926 (the first year of the continuing census of mental institutions) to a peak of 5.1 per 100,000 population in 1939. In view of this, a fall in the incidence of paresis during this period appears to be unlikely. On the other hand, the rise in paresis admissions is closely related to a rise in admissions for all psychoses during this period, and thus paresis represents a fairly constant percentage of the total first admissions for psychoses (table 2). Consequently, the rise in first admissions for

Figure 2. Paresis mortality and first admissions to mental institutions in the continental United States. Rates per 100,000 population, 1900–1951.



paresis more likely represents an increase in hospitalization of paretic patients associated with an increase in hospitalization of all patients with psychoses rather than increased incidence of paresis.

The conclusion that treatment of patients rather than decreases in incidence was responsible for the declining mortality, 1923 to 1938, is further supported by the relationship between first admissions and mortality. A good inverse correlation ($r=-.82$) indicates that increases in first admissions were closely associated with the fall in mortality, very probably as the result of an increasing proportion of cases being brought to treatment and hospitalization.

It is interesting to observe that in 1922, and probably until 1926, the deaths from paresis exceeded the first admissions to public and private institutions in the corresponding year (table 2). It is probable that a great many paretic patients were not hospitalized prior to and during the early 1920's. At present, the number of deaths in mental institutions attributed to all forms of syphilis greatly exceeds the number of deaths from paresis, and it is likely that most deaths from paresis occur among patients hospitalized in mental institutions.

Although malaria and other fever therapy were instrumental in reducing the mortality from paresis, the burden of the support of paretic patients during their stay in a mental institution and the cost of their treatment still fell largely upon the taxpayer. Fever therapy tended to increase this cost by extending the length of stay of many patients. Reduction of the incidence of paresis could have saved much of this expense.

The trends of the paresis mortality and first admissions statistics for the years 1938 to 1951 (fig. 2) appear to be best described by negative growth or decay curves, and no slope figures have been calculated for this period. The geometric mean death rate for this period is 2.4 compared to 4.3 for the period of fever therapy (1923 to 1938), and 6.7 for the prefever period (1900 to 1923). The change in classifications of death after 1948 brought about by the sixth revision of the international lists, however, may have exaggerated the decline in paresis mortality rates in recent years.

1938–1951

During the opening years of the national syphilis control program (1938 to 1944) and just prior to it there is a level trend in paresis mortality, and it appears that fever therapy could not be expected to reduce the rate any further. The rate of first admissions showed a downward trend beginning in 1940, shortly after the start of the national control program, but the trend of paresis mortality did not turn downward again until 1944, a lag of 4 years from the year the first admissions began to decline. After that date, the trend of mortality closely follows the trend of first admissions. The correlation coefficient for the entire period from 1938 to 1951 is plus .98, indicating a very close relationship between the two series.

Table 2. First admission rates for paresis per 100,000 population to State institutions and to all mental institutions, and admissions for paresis as a percent of all psychoses admissions in State institutions, continental United States, for the years indicated

Year	Paresis first-admission rates, all institutions [1]	Paresis first-admission rates, State institutions	Paresis admissions as a percent of all psychoses, State institutions
1922	5.7	4.5	10.1
1926		4.1	9.5
1927		4.3	9.6
1928		4.2	9.3
1929		4.1	8.9
1930		4.1	8.7
1931		4.3	8.7
1932		4.5	9.2
1933	5.7	4.7	9.2
1934	5.8	4.6	9.3
1935	5.8	4.7	9.1
1936	5.9	4.8	9.0
1937	5.8	4.7	8.7
1938	6.0	4.7	8.8
1939	6.1	5.1	9.3
1940	5.7	4.7	8.7
1941	5.7	4.8	8.5
1942	5.6	4.9	8.3
1943	5.3	4.7	8.1
1944	5.3	4.6	7.8
1945	5.1	4.3	7.6
1946	4.4	3.8	6.9
1947		3.4	6.4
1948		3.0	5.4
1949		2.5	4.6
1950		2.1	3.8
1951		1.6	3.0

[1] Includes Federal, State, county, city, Veterans Administration, and private facilities; excludes temporary care institutions. Available only for the years indicated.

Paresis represents a diminishing percentage of first admissions for all psychoses during this period although there was a continued growth in first admissions for all psychoses. The reduction in first admissions for paresis may be interpreted as a decrease in the incidence of paresis since it is contrary to the trend of all psychoses with which it was closely associated in the previous period.

The decline in the incidence of paresis, beginning in 1940, can be attributed to the finding and treating of syphilis cases before they reach the disabling stages. As might be expected, the effects of decreasing incidence of paresis was reflected in a declining mortality rate. It may be noted that the declining trends in incidence and mortality of paresis were already well established before the wide-scale introduction of penicillin therapy for syphilis in 1946.

Reduction in Mortality

To obtain an approximation of the reduction in paresis mortality attributable to fever therapy and to the national venereal disease control program, it was assumed that the rates of mortality due to paresis for the prefever period and the precontrol program period applied to the present population. Rates for paresis deaths specific for age, race, and sex groups for the registration States of 1922, the year just prior to the introduction of malaria therapy, were applied to the United States population of 1948. The year 1948 was chosen to insure comparability since it was the last year before the adoption of the sixth revision of the International Lists of Causes of Death. If the premalaria therapy mortality conditions of 1922 had applied to 1948, 11,255 deaths would have resulted from paresis instead of the 2,913 recorded, a reduction of 8,342 deaths which may be attributed to the combined factors of fever therapy and control measures.

The paresis mortality rates by race, sex, and age of the final precontrol program year of 1937 were applied to the 1948 population to estimate the mortality in 1948 had there been no control program. The number of deaths that would have occurred in 1948 at 1937 rates is estimated

to be 4,851, a difference of 1,938 from the 2,913 deaths actually recorded. Since paresis mortality exhibited a level trend in the late 1930's, this estimated reduction in deaths may be attributed to the national venereal disease control program.

There are, of course, factors that influence the difference in the estimated and actual deaths which are not adjusted by this method, but it is believed that these factors exert an upward influence in the aggregate upon paresis mortality. It is patently impossible to divorce the mortality from one particular cause from the mortality from all other causes in such widely separated time periods. However, paresis is a chronic disease, and the reduction in deaths from all causes has been principally a reduction in deaths from acute diseases during this period. This has exerted an upward influence on the mortality from syphilis, and it is possible that the specific rates for paresis would have been higher in 1948 than in 1922 and 1937 if there had been no fever therapy and no control program (*10*).

Another assumption inherent in this estimate is that the incidence of syphilis and paresis would have remained essentially the same throughout the time period from 1922 to 1948 had there been no control program. While this hypothetical trend is not subject to mathematical evaluation, it is probable that, in the absence of control measures, the incidence of paresis would have increased under the pressure of wartime social conditions. It is believed that the technique used herein to estimate the reduction in mortality has yielded a conservative figure.

Since every death from paresis is preventable, the death of any individual at a particular age represents a loss of some additional years of life which that person might have lived had he not died prematurely of paresis. By use of a life table technique, this loss of life expectation may be calculated. The number of deaths occurring to individuals of specific 5-year age groups, by race and sex, in 1948 was multiplied by the average number of years of life remaining to individuals of that population group, according to 1948 life tables (*4*). The summation of years of life lost by deceased paretic patients of each age, race, and sex group yielded an estimated 63,057 years of life expectancy lost to all persons who died from paresis in 1948.

Economic Aspects

By modifying this technique slightly and making some additional assumptions, the economic losses due to these premature deaths and the savings attributable to the control program may be estimated. The ages 20 through 65 years were assumed to be the productive years, and the loss of life expectation within these ages was calculated for the persons dying of paresis in 1948, based on the expectation of life in the 1948 life tables. On this basis, an estimated 34,713 productive years of life were lost because of premature deaths from paresis in 1948. If the paresis death rate prevailing in 1937 had pertained to 1948, an estimated total of 72,826 productive years of life would have been lost. A saving of 38,113 years of life expectancy resulted from the reduction of paresis mortality between 1937 and 1948. A typical calculation (for white males) is given in table 3.

Since not every person is employed or seeking

Table 3. Expected productive years of life lost from paresis in 1948 and savings of productive life expectation, white males, 1937–48

Age group	Expectation of life to age 65 in 1948	Estimated number of deaths in 1948 at 1937 rates	Actual deaths in 1948	Estimated loss of life expectation in 1948	
				At 1937 death rates	At 1948 death rates
20–24 [1]	40.8	[1] 23	[1] 8	938.4	326.4
25–29	36.2	34	8	1,230.8	289.6
30–34	31.5	127	20	4,000.5	630.0
35–39	26.8	277	55	7,423.6	1,474.0
40–44	22.2	351	99	7,792.2	2,197.8
45–49	17.7	355	174	6,283.5	3,079.8
50–54	13.3	425	172	5,652.5	2,287.6
55–59	9.0	411	259	3,699.0	2,331.0
60–64	4.7	293	254	1,377.1	1,193.8

Total loss of productive years in 1948 at 1937 rates	38,397.6
Total loss of productive years in 1948	13,810.0
Savings	24,587.6

[1] Includes all estimated and actual deaths under 25 years of age, but includes loss of life expectation only from age 20 to 65.

Table 4. Present value of the losses and savings of expected earnings as a result of reduced mortality from paresis, white males, 1937–48

Age	Expectation of life to age 65	Present value of $2,212 [1] per year to age 65 at 3 percent interest	Number of persons expected to be employed if living of those dying in 1948		Income lost in 1948	
			At 1937 death rates	At 1948 death rates	1937 death rates	1948 death rates
20–24	40.8	$51,656.56	20	7	$1,033,131.20	$361,595.92
25–29	36.2	48,441.14	33	8	1,598,557.62	387,529.12
30–34	31.5	44,670.45	122	19	5,449,794.90	848,738.55
35–39	26.8	40,340.23	271	54	10,932,202.33	2,178,372.42
40–44	22.2	35,476.62	344	97	12,203,957.28	3,441,232.14
45–49	17.7	30,032.98	340	167	10,211,213.20	5,015,507.66
50–54	13.3	23,963.24	407	165	9,753,038.68	3,953,934.60
55–59	9.0	17,222.87	368	232	6,338,016.16	3,995,705.84
60–64	4.7	9,557.89	262	227	2,504,167.18	2,169,641.03

Income which would have been lost in 1948 at 1937 rates **$60,024,078.55**

Income actually lost in 1948 ..... **$22,352,257.28**

Savings to national income through reduction of paresis mortality, 1937–48 ..... **37,671,821.27**

[1] Average earnings per employed civilian wage earner in 1948 (*11*, *12*).

employment, some adjustment of these figures is necessary before lost earnings may be estimated. The assumption was made that the proportion of the persons in each age and sex group of the general population in the labor force in 1948 (*11*) would also be typical of the paretic patients in this study. For example, 98.0 percent of the males aged 35 to 39 in the general population were in the labor force, but only 36.9 percent of the women in this age group were employed or seeking employment. The number of paresis deaths in each age bracket was adjusted downward by the appropriate percent before additional calculations were made. It was assumed that this proportion would remain constant over the expected years of life of each group, and that the estimated number in the labor force would be continuously employed.

In 1948 the average wage per employed civilian was $2,212 (*11*, *12*). Although this figure may be somewhat high for persons in the socioeconomic groups in which most paretic patients are found, it is probably the best estimate obtainable at present. If it is assumed that paretic patients would have earned this average figure for each year of the years of life expectation lost up to age 65, this series of annual earnings for the expected productive years of the persons concerned may be reduced to a single equivalent cash value in 1948. The cash value of these earnings in 1948 is the amount which, invested in 1948 at a nominal interest rate, will earn enough so that interest and principle would be sufficient to cover the annual earnings as they accrued. The calculation for white males is shown in table 4. The conservative rate of 3 percent interest was used as the basis for the present value of the estimated earnings. As estimated by this method, the value of total earnings lost to persons who died from paresis in 1948 amounted to $45,714,160 compared to $95,127,717 which would have been lost under precontrol mortality conditions. A savings of $49,413,557 in earnings may therefore be attributed to the control program. The effect of the loss of this earning power upon the families of these persons is not included in this estimate, nor is the cost of the yearly burden of maintaining these paretic patients in mental institutions. In 1951 alone this cost of maintenance is estimated to be in excess of $30 million. It should be emphasized that these figures pertain only to the mortality of a single year, 1948, and that similar estimates could be made for other years.

Although these estimates are based upon several broad assumptions, it does give some indication of the magnitude of the economic effects of paresis and the value of controlling syphilis. If the present downward trend of paresis incidence and mortality continues as expected, the investment in syphilis control will continue to yield abundant returns.

Summary and Conclusions

1. For the period 1900 to 1923 during which there was no effective syphilis control program and no effective therapy, the trend of paresis deaths was irregular and the slope of the trend line was not significantly different from zero.

2. Malaria and other fever therapy were successful in reducing the mortality from paresis in the years 1923 to 1938, but the incidence of paresis as measured by first admissions figures did not diminish during this period.

3. Mortality from paresis apparently had reached a plateau shortly before the start of the national syphilis control program in 1938 and no further reductions seemed likely through fever therapy.

4. Soon after its inception, the national syphilis control program apparently was effective in reducing the incidence of paresis. Reductions in paresis deaths followed after a period of about 4 years.

5. Further reduction in first admissions and in mortality from paresis is indicated by the present trend.

6. Losses of expectation of life due to premature death from paresis amounted to 63,057 years and loss of income associated with this loss of life totaled $45,714,160.

7. The savings of productive years of life expectation for the estimated deaths prevented in 1948 by the national venereal disease control program amounted to 38,113 years. The value of the earnings of the persons saved in 1948 was estimated to be $49,413,557.

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Recovery of Rabies Virus From Colonial Bats In Texas

By THELMA D. SULLIVAN, M.A.
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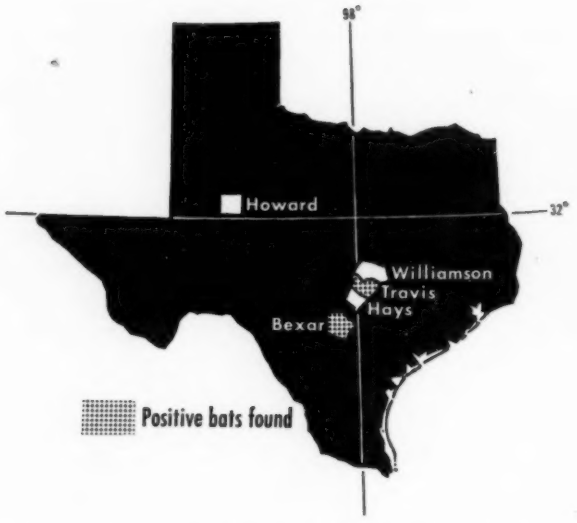
THE ISOLATION of the rabies virus from a leaf-nosed bat taken in Blumenau, Brazil, was first reported by Haupt and Rehaag (*1*) in 1921.

Hurst and Pawan (*2–4*) demonstrated the natural infection of the vampire bat (*Desmodus rotundus*) with rabies virus and observed that these bats were capable of transmitting the agent for several months as symptomless carriers. Pawan (*5*) showed that fruit-eating bats of the genus *Artibeus* have also survived for months as asymptomatic carriers, even though their saliva became infectious. Johnson (*6*) recorded that he and Ten Broeck recovered the rabies virus from the vampire bat (*D. rotundus*) in Mexico. Málaga-Alba (*7*) later found rabid vampire bats in Sonora, Chihuahua, and Tamaulipas, three states in Mexico which border the United States.

The existence of rabies in bats in the United States was suspected in December 1951 when Dr. J. E. Hogan of Big Spring, Tex. (Howard County), notified the Texas State Health Department about a woman who had become ill approximately 3 weeks after being bitten by a bat she had picked up by the roadside. The bat was not tested for rabies or specifically identified. Sulkin and Greve (*8*) reported that the patient had symptoms suggestive of bulbar poliomyelitis after becoming ill, and she died shortly afterward in a Dallas hospital. On autopsy, Negri bodies were discovered in brain material.



The first findings of rabies in bats of the United States came from the Florida State Board of Health Regional Laboratory at Tampa (*9*) in June 1953 when Negri bodies were found in the brain of a Florida yellow bat (*Dasypterus floridanus*) which had attacked a child. Later, the rabies virus was recovered from brains of 5 additional Florida yellow bats and from 1 Seminole bat (*Lasiurus seminolus*). These 2 species are noncolonial, insectivorous, and indigenous to the southeastern United States.

Several weeks after the Florida report, the rabies virus was recovered from the brain of a bat (*Lasiurus cinereus*) which without provocation had attacked a woman near Carlisle, Pa. (*10*).

The present report concerns the recovery of the rabies virus from colonial, insectivorous bats collected in the central and south central parts of Texas. Two hundred bats were taken in Howard, Bexar, Hays, Travis, and Williamson Counties, Tex., in November and December

Mrs. Sullivan is senior bacteriologist; Mr. Grimes, assistant bacteriologist; Dr. Eads, senior medical entomologist; Mr. Menzies, medical entomologist; and Dr. Irons, director of laboratories in the Texas State Health Department.

1953. They included 151 Mexican free-tailed bats (*Tadarida mexicana*), 42 cave myotis (*Myotis velifer*), and 7 pipistrels (*Pipistrellus subflavus*). Taxonomic assistance in identifying the bats was provided by Dr. W. Frank Blair, mammalogist, University of Texas.

Methods of Detecting the Virus

All bats collected were individually numbered. In the laboratory, their brains were removed aseptically, and impression smears were prepared and examined for the presence of Negri bodies.

The brains were prepared for inoculation into mice immediately or preserved in a 50-percent glycerin-saline solution for processing as time permitted. The brains were macerated in sterile mortars, suspended in a broth containing penicillin (1,000 units per cc.) and streptomycin (250 units per cc.), and eluted in a cold vault for at least 2 hours. The glycerinated brains were washed in a sterile saline solution prior to being treated as the fresh brains.

The supernatant fluid from each brain suspension pool was then inoculated into white mice by the intracerebral and intraperitoneal routes. Each pool was prepared from the brains of 1 to 5 bats of the same species, with a single exception.

Findings

A rabieslike agent pathogenic for mice was obtained by inoculating 4 mice with brain tissue removed from 1 *T. mexicana* and from 1 *M. velifer* (inadvertently mixed). Both of these bats were taken at Camp Bullis in Bexar County, Tex., in November 1953. The *T. mexicana* was taken from an officer's quarters at the camp, and the *M. velifer* from a bat retreat known as headquarters cave. Seven days after inoculation, 1 mouse showed symptoms of rabies, and 3 mice were dead. The brains of all 4 mice were found to contain Negri bodies.

The brain taken from the ill mouse was found to be bacteriologically sterile, and its passage resulted in the death of 1 of 6 mice and abnormal behavior in the remaining 5 on the fifth day. Negri bodies were found in the brains of these mice. Aerobic and anaerobic cultures for bacteria were negative. The agent was infectious for mice when injected into the peritoneal cavity, but the incubation period was somewhat prolonged.

The identity of the agent was further established by means of the serum-virus neutralization test. The antiserum had been prepared in rabbits against a strain of fixed rabies virus.

Confirmation of the source of the rabies virus was obtained by a second isolation from the original bat brain pool. It was unfortunate that the brains of the two different species of bats were mixed since it then became questionable which species, if not both, was infected. Examination of the smears of the original bat brains revealed Negri bodies in the brain of the *T. mexicana* but not in the brain of the *M. velifer*.

A similar pathogenic agent was obtained from the brain of a *T. mexicana* taken inside a trailer shed on the premises of the Texas State Health Department in Austin (Travis County) on December 4, 1953. The bat was found in a torpid condition on a wall near the ground, whereas other bats in the area were active. On the seventh postinoculation day, all mice inoculated with the bacteriologically sterile brain suspension from this bat were paralyzed. On the eighth day, 1 mouse was dead, and the remainder were sacrificed. Negri bodies were demonstrated in brain smears from these mice as well as in a second series of mice inoculated with a brain suspension from the dead mouse.

A second recovery of the virus from the original bat brain suspension verified the origin of the infectious agent. Confirmatory evidence of the identity of the virus was afforded by its neutralization with fixed virus antirabies serum.

Discussion

The behavior of the canine rabies virus in insectivorous bats has been studied in a limited way by Reagan and Brueckner (*11*) who successfully inoculated two species (*Eptesicus fuscus*, *Myotis lucifugus*). Several passages were made in the big brown bat, *E. fuscus*.

The significance of the finding of rabies virus in the common Mexican free-tailed bat (*T. mexicana*) is unknown. Since the two infected

bats were taken in unnatural locations, the possibility exists that the animals ill with rabies leave their colonies and seek solitude. If true, this would lessen the chances for spread of the infection. These are, of course, preliminary observations.

The present information on rabies in bats in the United States is too limited to formulate specific control measures. Certainly the destruction or abatement of the *T. mexicana* is not justified, but it does appear that the public should be warned relative to the dangers inherent in the handling of sick bats.

These insectivorous bats are present in large numbers in caves and dwellings in the southwest and are known to migrate into Mexico. Sanborn (*12*) has reported the recovery of a banded specimen in Mexico which had flown 800 miles from the Carlsbad Caverns in New Mexico.

Further studies on the percentage and species of infected bats in Texas and their importance in the epizootiology of rabies are now being conducted by the Texas State Department of Health.

Summary

Two strains of rabies were recovered from the brains of colonial bats in Texas. One strain was obtained from pooled brain tissue comprised of 1 *Tadarida mexicana*, which contained Negri bodies, and 1 *Myotis velifer*, which contained no Negri bodies. The second strain of rabies virus was isolated from the brain tissue of a single *T. mexicana*. These were among a total of 200 colonial, insectivorous bats collected and tested for rabies by the Texas State Department of Health in November and December 1953. The following species were included: 151 *T. mexicana*, 42 *M. velifer*, and 7 *Pipistrellus subflavus*.

This is the first reported recovery of rabies virus from naturally infected colonial bats in the United States.

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Key to Bats of Western North America

A key to the bats of western North America (north of Mexico) will aid in identifying 27 species of bats which are now known to be from North America north of the Mexican border and west of the 110th meridian. The key was prepared by Philip H. Krutzsch of the Museum of Natural History, University of Kansas, and is included as No. 133 in the series of *Natural History Miscellanea* published by the Chicago Academy of Sciences, 2001 N. Clark Street, Chicago, Ill.

Epidemiological method and studies of human capacity are needed for the complete reappraisal of traffic safety programs. These approaches are discussed in this article and the one which follows.

The Neglected Element in Highway Safety

By PAUL H. BLAISDELL, M.A.

FOR MORE THAN a half century the safe and smooth flow of traffic on our highways has been a race among technological advancement, economic necessity, and humanitarian application, with the human aspect running a poor third.

There is no better example of the fallacy of worship at the shrine of technology than that contained in the appalling highway accident record. Our mechanical aptitude really asserted itself in the late 1800's when the automobile reached the American scene. Before we learned to adjust ourselves to our new mobility, our inventive genius had made the automobile faster, more efficient, cheaper, and apparently well within the capability of the average individual to know how to start, steer, and stop. The motive power, which was to knit us together as a Nation more certainly, even, than rapid communication, was also to exact a terrible price in the destruction of life, limb, and property. In other words, our social maturity failed to keep pace with our technological attainments, and until we can bring both sides of this equation into balance there is no prospect for sustained sanity on the streets and highways.

Mr. Blaisdell, director of the traffic safety division, accident prevention department of the Association of Casualty and Surety Companies, has had 20 years of close association with the various enforcement and safety phases of traffic and transportation. His address before the American Association for the Advancement of Science in Boston, December 1953, is presented in condensed form.

Mechanical Marvel

As new vehicles created the need for new roads, new roads set the stage for newer vehicles. The rough dirt roads and trails capable of accommodating the wagon gave way to graded gravel surfaces and finally to those first 16-foot widths of macadam. The hand crank disappeared with the self-starter; the hard rubber tire gave way to the pneumatic variety; the one-man top to the greater comfort of the sedan; and two-wheel brakes to the greater safety of a braking surface on all four wheels. Somewhere along the line dawned the realization that accidents were displacing war and disease as the foremost agent of sudden death and that traffic led the parade in the accident toll. If, at that time, we had appreciated the simple truth that while improvement in roads and vehicles had been solid and steady there had not been 1 milligram of change in the basic traits, capabilities, and aptitudes of the human mechanism controlling the vehicle and using the roads, we might have averted the traffic tragedy which followed.

Perhaps no one knows how much money has been poured into highway construction, repair, and maintenance during the past 35 years in all States, counties, and local political subdivisions, but the most elementary mathematics tells us that it exceeds 60 billion dollars. During the same span some 2 trillion, 450 billion dollars has gone into the purchase of new passen-

ger cars, trucks, buses, parts, accessories, and gasoline.

To regulate the mushrooming volume of traffic, we have enacted laws by a hit or miss pattern, stubbornly refusing to bring about uniformity, persisting in the contention that each State and each municipality has some unique set of conditions which makes its problem a little different from that of even its nearest neighbor. Into this philosophy we have injected engineering, enforcement, and education as the means of assuring a safe, smooth flow of traffic. At the same time we have expected the same identical methods to create and sustain a social consciousness for the individual responsibilities of driver, passenger, and pedestrian. We should not be surprised at the dismal result.

The highway engineer can and does build roads which are capable of sustaining heavy volumes of traffic and still remain suitable for years of usage. The traffic engineer, a professional newcomer born of the highway scramble, channels the varying types of traffic, removes pedestrians from the vehicular lanes, devises superhighways and, insofar as current knowledge will permit, constructs safety into the very road itself. The automotive engineer designs and builds a great safety potential into the modern car. Mix all of these together with mere man as the catalyst and we have an engineering marvel which is a potentially greater menace than almost any of the instruments of destruction we have been able to devise.

Human Engineering Lags

As though the lag in human engineering were not enough of a problem, we have so misled the thinking of today's driver that his inflated ego distorts his judgment and has given him a superman complex which believes it can operate a car of today at sustained high speeds and still escape the possibility of disaster. The number of vehicles continues to grow and so therefore does the traffic congestion, the highway deaths, personal injuries, and property damage. To unravel the snarl, we hear the cry for more, better-designed roads, which, in turn, will bring more powerful vehicles and will further aggravate the results of human fallacy in using the new creations. Not more than once in a thousand times, when someone offers a solution to the traffic problem, do we hear it suggested that we spend some of our time, money, and research capabilities on taking apart the human dynamo at the wheel to determine why he reacts as he does to the situations of modern highway transportation.

Community, State, and Federal governments extract taxes for roads, vehicles, fuels, and licenses. During 1952 approximately 6 billion, 735 million dollars was taken in, and of these revenues 5 billion, 453 million dollars went back into road construction. Some of the balance was used for highway administration. Nearly 250 million dollars was diverted to other than highway purposes. During this period about 12 million dollars was devoted to driver education in the public high schools of the Nation. With this sum we reached only 54 percent of the eligible students and 43 percent of the high schools. Should we expect miracles if we are willing to devote only a small fraction of our highway income to the creation of a proper driver attitude? During the year 1952 the sale of new cars topped 26 billion dollars and we spent another 12 billion dollars to keep our automotive empire moving. During the same period less than 1/100th of 1 percent of this total went into all forms of highway safety and a minuscule portion of that amount into the search for an answer to the riddle of the human being at the wheel.

To the allegation that we can achieve highway safety by slide rule, transit rod, drafting table, spot maps, new roads, and more powerful vehicles, we can only submit the record for consideration.

The mayor of Pittsburgh, when addressing the 1953 annual meeting of the Citizens Traffic Safety Board in New York, reported: "During the past several years 9 out of every 10 accidents in Pittsburgh have been the result of a violation of traffic regulations." The answer needed is why those drivers committed a traffic violation.

Traffic Accident Causes

In a rundown of traffic accident causation in the 1953 volume of the National Safety Council's Accident Facts, these significant figures on fatal traffic accidents appear:

28 percent were caused by excessive speed.
22 percent involved a drinking driver or pedestrian.
16 percent were under adverse weather conditions.
12 percent resulted from an obstruction to vision.
7 percent came about through a defective vehicle.
5.5 percent were caused by a physical defect of the driver or pedestrian.

We cannot regard any of these traffic accident causes as truly basic. We must ask:

1. Why did the drivers exceed the speed limit?
2. What is the quirk of human behavior that insists upon drinking and driving?
3. When weather conditions were obviously bad, why did the individual operate a vehicle in such a manner that it could not be controlled?
4. When fog or rain, snow or sleet, cut off vision through the windshield, or when a building or a bush made it impossible to see the other approaching vehicle or the approaching train, why did the driver "bull" ahead as though visibility were perfect?
5. Why will drivers knowingly operate a car which has but one headlight in operation or brakes for which no amount of pumping will produce an effective application?
6. Why will a driver willfully expose himself, his family, and others to the dangers of his performance at the wheel when he knows that his eyesight or his heart or some other physical condition makes him unfit to be on the road?

When we can answer these questions we will begin to know something about traffic accidents. We will be in a position to determine who may drive. We will be able to counteract false security with solid safety facts and to devise a program of highway safety based on human ability to perform rather than on the technological advancement of vehicles and roads. And we will start penetrating the human behavior pattern with some lasting effect.

Speed Control Project

In the summer months of 1953, 11 northeastern States concentrated on control of highway speeds as a means of reducing traffic accidents. The States were Pennsylvania, New York, New Jersey, Connecticut, New Hampshire, Rhode Island, Massachusetts, Maine, Vermont, Delaware, and Maryland. This project established a trend showing that increases in convictions for speeding were accompanied by a drop in the number of traffic deaths, injuries, or property damage accidents, or some combination of 2 of these 3 objectives. The program added valuable information to the fund of traffic facts. It told us nothing about why speeds were so excessive that more convictions were possible.

As a part of the northeastern project, the Center for Safety Education of New York University operated its radar research car on a 15,000-mile tour of 11 States. Some of the findings of radar research on the speeding problem are most enlightening, for example:

1. From 25 to 90 percent of the drivers exceed the 25 mile an hour speed limit in residential areas.
2. Motorists pay little or no attention to traffic signs, especially speed zoning, caution and curve warnings, and school-slow indications.
3. The incidence of excessive speed rises sharply at night, with the greatest amount of fast driving after midnight.
4. The motorist is getting progressively more irritable. Delays due to congestion and poorly timed lights, the inadequacy of highways to accommodate the traffic load, and overheated motors from crawling traffic all tax the emotional capacity of drivers. There are more evidences of discourtesy, horn blowing, chance-taking, driving too fast after passing a congested area, and trying to make up for lost time.
5. The tendency to exceed speed limits is not confined to any type or class of drivers or to any group of old or new vehicles in the hands of those drivers.

Despite this evidence, and a hoard of similar facts, colleges and universities are pouring money and skills into research on methods of speed control, while we are not even close to the maximum use of our present knowledge of how to control highway speeds. We are almost totally ignorant of what speed is suitable for the mental and emotional stability of today's driver and his need for care and caution. The stepping up of research suggested in 1948 by the President's Highway Safety Conference has brought about 10 or 20 independent projects, but too many of them are aimed at vehicle

design deficiency or other mechanical elements in the traffic problem. We might legislate a requirement for passenger safety belts in all highway vehicles. However, we could not legislate a perpetual conscience to remind drivers and passengers of the necessity for fastening that belt into position. We could make the ridiculous mistake of requiring a governor on every motor vehicle to limit its maximum speed, but we could not take away from the individual his skill as a hairpin mechanic to make the governor inoperable.

The transit and trucking industries are probing into driver selection through tests which place more emphasis upon attitudes, social behavior, reactions, and health than on fragmentary knowledge of traffic laws, the ability to distinguish red from green, and competence at angle parking. This is one of the few signs of scientific advancement in the human factor of highway safety. And at least one State, Colorado, now requires psychiatric examination for persistent violators of the traffic laws.

There are certain things, requiring great faith and even greater moral courage, we must do before the conservation of human resources on our highways is a reality rather than a remote goal. We may come to such a program only as a last resort, or we may have a new birth of social understanding which will insist upon drastic steps for drastic conditions.

Proposed Program

First, we need a complete reappraisal of the highway and traffic program in terms of human capacity rather than the efficiency of roads and machines.

Second, as a preliminary to highway safety based on man's behavior, we need research and more research and all the money it requires to conduct that research to find out why the highway user reacts as he does to traffic problems, to the rules of orderly traffic, and to the enforcement designed to protect others and to save him from his own foolhardiness.

Third, public and private schools should inaugurate, without delay, a program of driver education which recognizes the predominance of the human element in highway usage and teaches the generations of new drivers ways and means of coping with technological giants while preserving an attitude of reasonableness, caution, and common courtesy. If we are to be a Nation of superhighway users we must learn to manage ourselves without exceeding our own capabilities and ending in disaster.

Fourth, once we have rewritten our laws and rules to fit human capacity, we must gear the machinery of enforcement to carry out compliance with the established limits by providing enough well-trained enforcement personnel and by eliminating inadequate judicial procedure in traffic cases. The slap-on-the-wrist tactics of the present day must give way to the strong whiplash of severe penalty. Those who cannot meet the requirements must be denied the driving privilege and no act of histrionics or economic pressure can be allowed to change the decision.

The basic problem is one of man's intelligent control over all the forms of power that he has learned to produce. Power machines have no sense of moral value and no minds of their own. They produce results that are good or bad, destructive or creative, depending upon the skill, understanding, and judgment of those who control them. The driver makes the difference. His, and his alone, is the decision from the moment he touches the starter until he applies the parking brake at the end of a given journey. His trip may end in satisfaction or it may end in tragedy, depending upon the driver's ability and willingness to use the vehicle with the level of intelligence and aptitude which made its creation possible.

It is unthinkable that scientific advancement in highways and vehicles should grind to a halt. We cannot hold progress in a state of suspended animation while human capacity catches up. But, we can stop the headlong rush up the wrong avenues to satisfactory adjustment by eliminating the erroneous impression that vehicles and highways can be so safe, in themselves, that human frailties are no longer important. The mere application of the prefix "super" does not automatically make a roadway safe. The quiet smoothness of the modern vehicle at 70 miles per hour does not mean that the need for undivided attention has been discarded. These corrections of attitude must be the assignment of the new driver education.

An Epidemiological Approach To Traffic Safety

By A. L. CHAPMAN, M.D.

ONCE THE SPECIFIC CAUSES of many of the acute infectious diseases became known, it was not difficult to develop effective programs to control them. We have been far less successful in controlling accidents and the chronic degenerative diseases. The principal reason for this failure has been a lack of knowledge concerning their causes.

Foremost among those who forged the programs that brought so many of the infectious diseases under control, and in some instances eradicated them, were epidemiologists. It is surprising that epidemiologists have not been given a more important part to play in finding out the real underlying basic reasons why traffic accidents occur, what kind of people have them, and what the precipitating factors are. It is reasonable to expect that any further significant decrease in morbidity and mortality rates from traffic accidents cannot be brought about until more is known about their causes.

The success of enforcement agencies in lowering mileage death rates is truly remarkable in the light of current ignorance concerning human factors in accident causation and accident proneness. This success alone merits the retention of traffic accident control programs in the hands of law enforcement agencies. However, it may be pertinent to note at this point that the position of epidemiologist seldom is found on a police department or motor vehicle bureau staffing chart.

If the conduct of epidemiological studies is a prerequisite for developing better methods of preventing traffic injuries and deaths, police agencies can benefit from the cooperation of other agencies. The most likely place to enlist that cooperation is among that group of agencies that normally employ epidemiologists. Foremost among these are State and local health departments, universities, and foundations.

This type of epidemiological cooperation may well be the support needed to develop traffic accident control programs based on facts instead of on only partially proved hypotheses.

The Human Factor

Fractionized public services may present a barrier before epidemiologists can be assigned to work on the accident prevention problem along with investigations carried on by police and motor vehicle bureaus. This barrier will have to be removed before new light can be thrown on this old problem. If this can be overcome, the valuable work already being performed by police and motor vehicle bureaus may develop into the broad and comprehensive investigations desired.

One important reason why an epidemiological approach to traffic safety is indicated is that most traffic authorities agree that traffic accidents, in the vast majority of cases, are caused not by automobiles but by drivers and pedestrians—in other words, by people.

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In 1952, according to data published by the National Safety Council, 94 percent of the cars involved in fatal accidents had no reported unsafe conditions at the time they were involved in a fatal traffic accident. The drivers were not so guiltless—61 percent were reported to be violating a traffic rule or regulation at the time of the accident.

Does anyone really know why drivers violate traffic laws and regulations; why drivers at certain times drive safely and at other times cast caution to the wind; or whether unsafe driving is compulsive or willful? What amount of unsafe driving is due to lack of driving skill; what amount to physical, mental, or emotional deficiencies?

Epidemiological studies are needed to answer these formidable questions. It is difficult to comprehend how a comprehensive traffic accident program can be devised until these questions are answered.

What It Would Cost

For the sake of specificity, the following estimate of the cost of an epidemiological study is presented. The data upon which the estimate is based can be found in the National Safety Council publication, Accident Facts—1953.

An average State having 3 million residents could be expected to experience about 730 traffic deaths and about 26,000 traffic injuries a year. One trained field investigator working under the supervision of an epidemiologist could reasonably be expected to conduct an adequate investigation of about 220 traffic accidents a year.

An epidemiological investigation would not necessarily have to be instigated at the scene of the accident. It probably would extend over a period of weeks, depending on the availability of those involved in the accident and those who might have played a part in developing an accident proneness on the part of the driver.

The difficulty of obtaining funds to support a new program would limit the size of the study to an investigation of all of the 730 traffic deaths, and only to a 5-percent sample (1,300) of the 26,000 traffic injuries. The minimum full-time staff for a statewide study of this size would require at least 9 field investigators, 1 biostatistician, and 1 clerk. The services of an epidemiologist would have to be obtained, at least part time, from any agency willing to cooperate in the study.

Fortunately, the cost of a small epidemiological study would not be exorbitant. One could be administered for about $60,000 a year. When this amount of money is compared with the amounts that have been spent on epidemiological studies of diseases that have taken far fewer lives than have traffic accidents, the amount seems trivial.

If a State health department undertook the survey, the salaries of some or all of the nine field investigators might be provided locally. This would greatly decrease the cost of the study to the State health department.

Only by a study of this type can we make sure that the surmises on which most of our control programs are being built are valid. Both British and American research workers indicate that about 80 percent of traffic accidents are caused by approximately 20 percent of the driving population.

A Moral Responsibility

If the real causes of traffic accidents were known, public administrators and legislators would be able to take any one of a number of remedial measures that repeatedly have been suggested from time to time. If it could be proved that physical or mental defects or emotional instability were factors which caused a significant number of traffic accidents, legislators would have a moral responsibility to correct the situation by requiring an annual physical examination of all drivers and, where indicated, a psychiatric evaluation.

In many States, cars are now inspected annually. Some States require semiannual inspections. If drivers and not cars are the cause of most traffic accidents, why do we insist on inspecting cars, but not the drivers?

If a lack of driving skill was found to be an important cause of traffic accidents, "behind-the-wheel" driver training courses could be required of all applicants for driving licenses before licenses were issued. It has been shown that high school students who have had "behind-the-wheel" driver training courses become

involved in 50 percent fewer fatal motor vehicle accidents than high school students who do not receive this type of training.

A lot of lives are lost each year, it would seem, by this failure to exploit fully a reasonably well-validated method of decreasing the number of traffic accidents. If it could be proved by adequate investigation that it is the human factor in high speeds that is an important cause of highway accidents, red light "visual" governors could be required on all cars. The blinking on and off of the governor's red light when speeds in excess of 60 miles an hour were attained might constitute prima facie evidence of reckless driving. Even the New Jersey Turnpike Authority has had to enforce a maximum speed limit of 60 miles an hour on the turnpike, largely as the result of an empirical decision.

By continued and extensive research, automobile manufacturers have built a high degree of safety, as well as speed, into their cars. Highway engineers and road builders have made highways safer to traverse at higher speeds.

Police agencies have been tireless and only somewhat successful in their efforts to curb speeding and reckless driving. They have been sorely handicapped by not having sufficient funds to employ all the enforcement officers they need. Unfortunately, the provision of enough State and local policemen to enforce existing traffic laws rigidly and consistently on every highway and byway in the United States would bankrupt the Nation. Even now, as high as 30 percent of the police force in many cities is assigned to traffic duty.

The reduction in the number of deaths per registered vehicle from 40 deaths per 10,000 registered vehicles in 1910 to 8 deaths in 1950 is a tribute to the continuous three-pronged program of education, engineering, and enforcement that has been conducted by police agencies, automobile associations, highway engineers, and the National Safety Council.

The mileage death rates have dropped in a similar manner, with a resultant saving of many lives. If the mileage death rate of 1937 had prevailed in 1950, there would have been 67,000 traffic deaths instead of 35,000 in the latter year. Unfortunately, the number of cars on the road increases each year, and the increasing number of miles being traveled cancels out the slow but steady decline in mileage death rates. That is why the annual traffic death toll has hovered for years between 30,000 and 40,000 deaths a year—an average of about 100 deaths each day.

That there are factors that can be brought into play to make driving safer and to teach drivers to drive more safely is evidenced by the spread between the high mileage death rate in South Carolina and the low mileage death rate in Rhode Island. In South Carolina, a predominantly rural State, the rate in 1952 was 12.0 deaths per million miles traveled. In Rhode Island, the comparative rate was 3.0.

In the District of Columbia, where the 1952 mileage death rate was 2.2, three beneficent influences are at work—excellent roads, a rigidly enforced speed limit of 25 miles an hour, and annual car inspections. Although speed has been indicated, more often by circumstantial implication than not, as a major factor in fatal traffic accidents, much more has to be learned about speed in its relationship to various types of drivers and to driving conditions. But no one has produced any proof that these are the exclusive causes per se of the low mileage death rates in the District of Columbia, or what are the true causes of the low rate in Rhode Island or the high death rate in South Carolina.

Until a new and more scientific light is thrown on the scene, the picture will remain about the same—or become worse—for the United States Bureau of Public Roads has estimated that by 1960 there will be nearly twice as many miles of highway travel as there were in 1940, and there is every reason to believe that this predicted increase in annual mileage will continue indefinitely.

Failure to take aggressive action along the lines suggested is not due to disinterest on the part of law enforcement agencies. When a police official or a legislator attempts to initiate a new phase of traffic accident control, the action is bound to be challenged. The administrator or legislator is asked to produce facts to back up the suggested action. In most instances the facts just aren't there. Nor will the facts ever be available until adequate epidemiological studies are conducted.

A Review of Accomplishments

The Clinical Traineeship Program Of the National Cancer Institute

By RAYMOND F. KAISER, M.D.

PARALLELING the increase in the magnitude of the cancer problem throughout recent years there has been an urgent and growing need for more physicians trained in the detection, diagnosis, and treatment of neoplastic diseases. Recognizing this need, the National Cancer Institute of the Public Health Service in 1938 initiated a clinical traineeship program under which graduate physicians could receive special training in cancer management.

These trainees were placed in medical schools, hospitals, and training centers where suitable cancer teaching material, as well as qualified professional staffs, was available, and acceptable training facilities could be provided. In order to provide the trainee an opportunity to select his own training center, and the training institution the opportunity to select its own trainees, the applicant is required to make his own arrangements with an acceptable institution before the traineeship request is considered. Applications submitted to the National Cancer Institute upon completion of such arrangements are considered by a board which awards the traineeships.

In the early years of the program, the trainee received a stipend of $6 a day; however, with changing economic conditions this stipend has been gradually increased to $10 a day, or a maximum of $3,600 annually.

The number of appointments, including renewals, has ranged from 3 during the fiscal year 1938 to 143 in the fiscal year 1954. Initially, only a small number of physicians could be appointed because of the limited appropriations available to the institute. Although, in time, the number was gradually increased, it was restricted during the war years owing to lack of suitable applicants. Since the close of World War II, the number has expanded considerably.

Among the objectives of the traineeship program are (*a*) the recruitment of more and better trained physicians to the cancer field; (*b*) the provision of competent physicians in the various branches of medicine concerned with cancer care around whom clinics and services may be organized; and (*c*) the provision of better care for the cancer patient.

Survey of Program

Questionnaires were sent in 1953 to all trainees who had completed their participation in the program prior to July 1953. The elapsed time between completion of the traineeship and the date of reply to the questionnaire ranges from a few months to approximately 15 years. This variation in elapsed time obviously has a direct bearing on the stage of career development of the particular individual as well as a direct relationship to an estimate of the accomplishment of the program at a given moment.

Dr. Kaiser, chief of the Field Investigations and Demonstrations Branch (formerly Cancer Control Branch), National Cancer Institute, Public Health Service, since 1951, and assistant chief from 1947 to 1951, was with the San Francisco regional office of the Public Health Service as general medical consultant from 1942 to 1946.

As of June 30, 1953, 451 physicians had received support under this program. Questionnaires were sent to all 451; only 53 percent of the total responded, however. Among the reasons for failure to reply are inaccurate addresses, continuation of the individual's training under other sponsorship, entry into the armed services, and, possibly in some instances, merely inertia on the part of the trainee.

This study is therefore based on the replies received from 237 individuals (231 men and 6 women). The incompleteness of this response is recognized, as are other limitations of the questionnaire method. However, these data are intended as a factual report on the activities of those individuals who did respond and are considered a representative sample which reflects significant trends of the accomplishments under the program.

Qualifications of Trainees

The minimum requirements for traineeships are graduation from an approved medical school and at least 1 year of rotating internship. All of the 237 trainees offered experience exceeding these requirements. Seventy-six had up to 1 year of postgraduate training prior to participation in the traineeship program; 62 trainees had 1½ to 2 years; 80 had 3 years; 17 had 4 years; and 2 had more than 4 years. Of the 237 trainees in this study, 129 had military service of varying periods. A portion of this military training included postgraduate train-

Distribution of cancer trainees at 53 training centers

State	Hospital	Number of trainees	State	Hospital	Number of trainees
California	University of California Hospital.	10	Missouri	Washington University	5
	Stanford University Hospital.	3		Ellis Fischel State Cancer Hospital.	5
Connecticut	Yale University School of Medicine.	3		Barnard Free Skin and Cancer Hospital.	5
District of Columbia.	George Washington University.	2		St. Louis University	1
	Georgetown University	2	New York	Memorial Hospital	59
Georgia	Emory University Hospital.	1		Bellevue Hospital	13
Illinois	Chicago Tumor Institute	3		Columbia University Hospitals.	10
	Michael Reese Hospital	3		Mount Sinai Hospital	2
	University of Illinois	2		Montefiore Hospital	2
	Provident Hospital and Training School.	2		Presbyterian Hospital	1
	University of Chicago	1		University of Rochester	1
Iowa	State University of Iowa	1	North Carolina	Duke University	5
Kansas	University of Kansas Medical Center.	4		North Carolina Baptist Hospital.	2
Kentucky	Norton Memorial Infirmary.	1		Bowman Gray School of Medicine.	1
Massachusetts	Massachusetts General Hospital.	4	Ohio	Cincinnati General Hospital.	2
	Peter Bent Brigham Hospital.	3		Western Reserve University.	2
	New England Deaconess Hospital.	2	Oregon	University of Oregon	1
	Massachusetts Memorial Hospital.	2	Pennsylvania	University of Pennsylvania.	16
	Lahey Clinic	1		American Oncologic Hospital.	3
	Pondville Hospital	1		Philadelphia General Hospital.	2
	Massachusetts Eye and Ear Infirmary.	1		Jeanes Hospital	1
Maryland	University of Maryland	6		Presbyterian Hospital	1
	Johns Hopkins Hospital	2		Jefferson Medical College	1
Michigan	University of Michigan	10	Tennessee	University of Tennessee	5
	Wayne University	1	Texas	Nix Hospital	1
Minnesota	University of Minnesota	17	Virginia	Medical College of Virginia.	1
			Washington	Swedish Hospital	1
			Total		237

ing, the duration of which is difficult to estimate.

In general, trainees are appointed for a 1-year period with the opportunity for two 1-year renewals, if extended additional training is desired. Appointments are continued on demonstration of satisfactory performance. The length of traineeship for the physicians in the study group is as follows:

Period (months)	Number of trainees	Period (months)	Number of trainees
Under 6	2	24	37
6	9	27	9
9	18	30	18
12	86	33	5
15	9	36	33
18	4		
21	3	Total	237

It will be noted that 29 of this group received traineeships of less than 1 year. The major reason for this short period of participation was a call to military service. Others were offered positions before the end of their appointments; a few wanted only a short period of training as a refresher following military service or to fulfill specialty board requirements; and a still smaller number were forced to discontinue training because of personal economic circumstances.

The major reason for continuance among those participating in the program for 1 to 3 years was a desire for more extensive cancer training and to meet requirements for the various medical specialty boards concerned with the cancer problem. When the length of traineeship is considered in conjunction with the pretraineeship experience of these physicians, a reasonably complete picture of their postgraduate training can be obtained. The study shows that 138 of the group had at least 5 years of postgraduate training at the time they completed their traineeships, and 99 had 5 to 10 years of training.

Training Centers

Obviously, this program is dependent on the cooperation of the teaching hospitals, medical centers, and teaching institutions of the Nation. Throughout the years of the program's existence, there has been wholehearted cooperation on the part of such organizations. At the inception of the program, only a limited number of institutions were available to provide cancer training, and these were largely centered in the eastern portion of the country. In the first year, trainees were placed in 3 institutions. As the program continued, additional centers were able to provide cancer training so that in this study trainees were distributed in 53 training centers as shown in the table on p. 777.

Location of Trainees

Of the trainees in this study, 72 remained in the general area of their training center on completion of postgraduate work, and 165 located in areas away from their training centers. The distribution of the trainees, by State, is as follows:

Location	Number of trainees	Location	Number of trainees
Alabama	1	Nebraska	1
California	31	New Jersey	5
Colorado	2	New Mexico	1
Connecticut	5	New York	37
District of Columbia	8	North Carolina	9
Florida	1	Ohio	12
Georgia	2	Oklahoma	4
Idaho	1	Oregon	2
Illinois	6	Pennsylvania	9
Indiana	2	South Carolina	1
Iowa	3	South Dakota	1
Kansas	4	Tennessee	4
Kentucky	5	Texas	12
Louisiana	2	Utah	3
Maryland	8	Virginia	6
Massachusetts	9	Washington	8
Michigan	6	West Virginia	1
Minnesota	9	Wisconsin	1
Missouri	12	Hawaii	2
Montana	1	Total	237

Thus, it will be seen that a majority of the States received the benefit of trained physicians locating within their borders.

Each trainee at the time of his appointment has indicated his intention to engage in some phase of cancer work on completion of his training. Although there is no mandatory requirement that the trainee continue in the cancer field, it will be noted in the results of the program which follow that the majority of trainees are carrying out their original intentions.

One hundred and seventy-four of the 237 trainees reported they had completed American board specialty examinations, and 61 reported they were board eligible and in the process of obtaining board certification. Four of the trainees, 2 of whom had obtained board certification, indicated they had decided to pursue careers in cancer research. Distribution of trainees in the various specialty groups is as follows:

Board certified

Surgery	79
Radiology	66
Pathology	22
Obstetrics and gynecology	6
Ophthalmology	1
Total	174

Board eligible and in process of certification

Surgery	30
Radiology	7
Pathology	10
Obstetrics and gynecology	5
Internal medicine	7
Urology	1
Physical medicine and rehabilitation	1
Research (already certified)	2
Total	63

Teaching Activities

One hundred and seventeen, or approximately 50 percent of the trainees responding to the questionnaire, indicated they were engaged in cancer teaching activities in medical schools at various academic levels. Seven of the group are cancer coordinators under the institute's undergraduate cancer teaching program. The following table reflects the teaching appointments held by trainees in this study:

Academic level	*Number of appointments*
Professor	6
Associate professor	17
Assistant professor	12
Senior instructor	2
Instructor	70
Associate instructor	3
Assistant instructor	3
Instructor for cancer research	4
Total	117

Cancer Services

Fourteen trainees have helped organize and establish new cancer clinics in their areas. One hundred and twenty-nine are members of the staffs of cancer clinics, and an additional 23 are directors of cancer clinics or chairmen of tumor boards. Seventeen are members of the staffs of detection centers, and 2 additional trainees are directors of detection centers. While some of these trainees were associated with more than 1 clinic or more than 1 type of cancer service, for purposes of this study they have been enumerated only once. A total of 171 were engaged in at least 1 such type of service activity. None of the trainees has gone into State or local health department cancer programs.

Hospital Staff Appointments

All but 2 of the trainees were associated with the staff of at least 1 hospital, and the majority held staff positions at several hospitals in their local area. Of the 2 exceptions, 1 died during the course of this study, and the second is a woman physician who gave up active medical practice because of family responsibilities.

Time Devoted to Cancer Work

A majority of the trainees are devoting a considerable proportion of their time to work with cancer patients. This statement is based on the data presented above indicating the trainees' associations with cancer teaching and cancer services plus an estimate by each of the trainees of the time spent on cancer work. This information is summarized as follows:

Time spent	*Percent*
Total	17.0
One-half	33.0
One-quarter to one-half	28.0
Less than one-quarter	21.5
Little or none	.5

Present Status of Program

In the fiscal year 1954, 140 physicians received appointments, approximately 59 percent of the number of qualified applicants sub-

mitting applications for training. Fiscal year 1954 trainees were distributed in specialty training as follows:

Radiology	49
Surgery	40
Pathology	33
Internal medicine	8
Obstetrics and gynecology	7
Hematology	1
Urology	1
Otolaryngology	1

Conclusions

To some extent, this analysis provides a means of evaluating the clinical traineeship program of the National Cancer Institute during the period 1938 to 1953. Data obtained from 237 trainees out of a total of 451 who completed their training indicate that at least 50 percent are devoting 50 to 100 percent of their time to cancer work; 49 percent are engaged in cancer teaching; and 72 percent are serving on the staffs of cancer clinics or detection centers. Cancer clinic facilities have been augmented as a result of the program.

Physicians who have completed these traineeships have become more proficient in the diagnosis and treatment of cancer. This is reflected in the fact that 73 percent have become diplomates of American specialty boards, and the remainder (27 percent) are either board eligible or in the process of board certification.

Of the former trainees who can be considered permanently located, 70 percent have established themselves in areas away from their training centers, thus providing cancer service to many different parts of the country.

The program has attracted a significant number of physicians to the cancer field who would not have entered it without the aid of this program. As a consequence, the program has been helpful in partially meeting the tremendous need for physicians trained in the various specialties vitally important to adequate management of the cancer case.

The need for better training in the cancer field is generally recognized, and this program affords a means of providing training which will eventually enable the general public in all sections of the country to receive better cancer services.

Sodium Content on Dietary Food Labels

New regulations under the Federal Food, Drug, and Cosmetics Act, requiring the labels of "salt free" or "low sodium" food products for dietary use to declare sodium content in milligrams of sodium per 100 mg. of the food and per average serving, will go into effect on September 29, 1954. The "average serving" is required to be expressed in common terms, such as number of slices, cookies, or wafers, or in cupfuls, tablespoonfuls, or teaspoonfuls.

In recent years, the increase in packing of special foods for persons suffering from high-blood pressure and certain types of heart, liver, and kidney diseases has been accompanied by variation and confusion in labeling terminology. Many products labeled "salt free" or "no added salt" contained substantial amounts of sodium, sometimes naturally present in the food, sometimes added in the form of baking powder or other ingredients.

Trends in Discharge and Length of Stay Of Patients in a Tuberculosis Hospital

By ABRAHAM GELPERIN, M.D., Dr.P.H., LEON J. GALINSKY, M.D., ROBERT J. ANDERSON, M.D., and ALBERT P. ISKRANT, M.A.

Since the advent of streptomycin, PAS, and isoniazid for tuberculosis, relatively little formal information has been published on the effects of chemotherapy on such matters as duration of hospital stay, discharges against medical advice, and other factors bearing on tuberculosis control. Little has been said, too, about the psychological impact of the effectiveness of this type of therapy on patient behavior and willingness to endure prolonged treatment.

Although the accompanying paper relates to the experience of a single institution with an admittedly small total population, it represents a beginning in the accumulation of formal knowledge growing out of the use of effective chemotherapy in tuberculosis. The observations are merely indicative, and not of general applicability, and it is hoped that their presentation will stimulate further study and reporting on this vital subject.

RECENTLY there has been much discussion regarding the effect of present treatment methods on the welfare of the tuberculosis patient, on his stay in the hospital, and on the degree to which home care is supplanting hospitalization and affecting future demands for hospital beds. To answer these questions ideally would involve lifelong followup of patients through their various admissions and readmissions to sanatoriums to determine the effect of modern therapy on hospitalization procedures and practices. Such studies should be done, but they involve long-term followup, not only in the immediate community served by the sanatorium but also in the areas to which patients have moved. Such a study was not attempted here. This study was made at Broadlawns sanatorium (Broadlawns Polk County Hospital, Des Moines, Iowa) to find out what has happened to patients discharged from hospital care. The study covers the single hospitalization period from the time these patients were admitted or readmitted with active pulmonary tuberculosis to the time they were discharged.

Ideally, this study would take the admissions in the various years and determine the length of hospitalization of each admission. This, however, cannot be done for the later years, as many of the admissions are still in the sanatorium. Instead, the discharges for each of the

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years, from January 1, 1946, through October 31, 1953, were analyzed. This study started with 1946 because this was the year before the introduction of streptomycin as treatment in this sanatorium. PAS (para-aminosalicylic acid) was introduced in 1948 and isoniazid in 1952.

Patients' status for each year from 1946 through October 31, 1953, for all discharges except transfers is shown in table 1 and figure 1. Patients admitted with minimal active tuberculosis are not shown separately because of their small number, but they are included in the total. In the following analysis we have described separately—because of different patterns—the status of discharged patients who had moderately advanced or far advanced tuberculosis on admission to the sanatorium.

Status on Discharge

For patients with moderately advanced tuberculosis, the trend in discharges appears to be toward a larger proportion leaving with medical advice and fewer leaving against medical advice. The proportion of patients dying has remained relatively constant. This is shown in table 1 and figure 1.

A definite trend toward "discharged with advice" and away from "discharged against advice" and "dead" is apparent for patients with far advanced tuberculosis. However, the most pronounced finding for all cases of tuberculosis is the decrease in the numbers and proportions of persons discharged against medical advice.

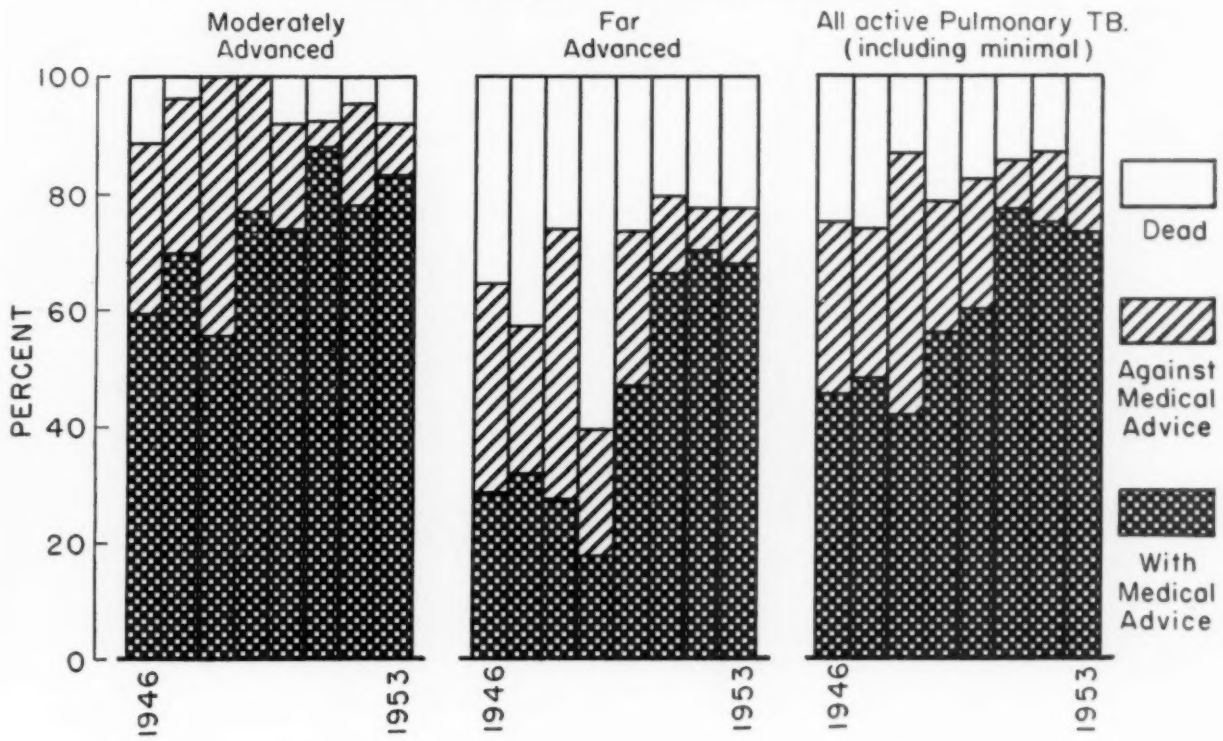
Length of Hospitalization

The duration of hospital stay of patients with moderately advanced tuberculosis discharged with medical advice appears to be decreasing from a peak of 820 days in 1949 to an average of 261 days in 1953 (table 2, fig. 2). There is no obvious trend in the average stay of those discharged against advice but the numbers for any year are small. The small number of deaths in this stage makes impossible any analysis of duration of stay for that category. In general, for cases admitted with moderately advanced tuberculosis, the duration of hospital stay ap-

Table 1. Discharges, excluding transfers, for tuberculosis patients with and against advice, and deaths, at the Broadlawns sanatorium, 1946 to Oct. 31, 1953

Stage on admission	Year of discharge	Total	Type of discharge					
			With advice		Against advice		Dead	
			Number	Percent	Number	Percent	Number	Percent
Moderately advanced	1946	17	10	58.8	5	29.4	2	11.8
	1947	30	21	70.0	8	26.7	1	3.3
	1948	27	15	55.6	12	44.4	0	0
	1949	30	23	76.7	7	23.3	0	0
	1950	23	17	73.9	4	17.4	2	8.7
	1951	24	21	87.5	1	4.2	2	8.3
	1952	23	18	78.3	4	17.4	1	4.3
	1953	24	20	83.3	2	8.3	2	8.3
Far advanced	1946	25	7	28.0	9	36.0	9	36.0
	1947	44	14	31.8	11	25.0	19	43.2
	1948	26	7	26.9	12	46.2	7	26.9
	1949	18	3	16.6	4	22.2	11	61.1
	1950	26	12	46.2	7	26.9	7	26.9
	1951	24	16	66.7	3	12.5	5	20.8
	1952	27	19	70.4	2	7.4	6	22.2
	1953	32	22	68.8	3	9.4	7	21.9
All active pulmonary tuberculosis (including minimal).	1946	47	21	44.6	14	29.8	12	25.5
	1947	77	37	48.0	20	26.0	20	26.0
	1948	53	22	41.5	24	45.3	7	13.2
	1949	50	28	56.0	11	22.0	11	22.0
	1950	51	31	60.8	11	21.5	9	17.6
	1951	49	38	77.5	4	8.2	7	14.3
	1952	52	39	75.0	6	11.5	7	13.5
	1953	58	43	74.1	5	8.6	10	17.2

Figure 1. Tuberculosis patients discharged from Broadlawns sanatorium, 1946–53, by type of discharge and stage of disease on admission.



pears to have increased from 1946 to 1949, in which year the average hospital stay was 682 days per case discharged. A gradual decline from 1949 to 1953 is apparent with the average duration of discharges decreasing to 249 days in 1953.

The duration of hospital stay for those patients with far advanced tuberculosis discharged with medical advice appeared to increase through 1949 and has remained rather high since. The hospital stay of far advanced cases dying from tuberculosis appear to have increased somewhat since 1946. In general it might be said that for far advanced tuberculosis, the hospital stay increased from 1946 to 1949 and possibly has leveled off since that year.

The duration of hospital stay for all pulmonary tuberculosis patients discharged with medical advice seemed to increase through 1949 and then level off. The duration of stay of all patients who died from pulmonary tuberculosis seems to have increased with the highest average number of days in 1951. In general, the duration of hospitalization increased by 1949 to a peak of 686 days per patient discharged. The average in 1953 was 533 days, which was much less than the peak in 1949 but still much greater than the 1946, 1947, and 1948 peaks.

Trend to Home Care

In 1951, 13 tuberculous patients previously discharged were found in need of care and were placed in a home care program. Subsequently, 66 additional patients have been discharged from Broadlawns to be treated at home under the direction of the hospital as follows: 14 in 1951, 27 in 1952, and 25 in the first 10 months of 1953. Three of these 66 patients received no hospitalization other than for diagnostic study.

Of 79 cases placed on home care to date (15 cases prior to July 1951), only 4 were classified as minimal in extent on discharge with 44 moderately advanced and 31 far advanced. Five cases were classified as active or questionably active on discharge and the remainder as arrested or apparently arrested.

A rather pronounced decline in the duration of hospitalization of those persons discharged to home care has occurred (fig. 3). Following

Table 2. Discharge status and duration of hospital stay in days for tuberculosis patients at Broadlawns sanatorium, 1946 to Oct. 31, 1953

Stage on admission	Year of discharge	With advice		Against advice		Dead		Total	
		Number of patients	Average stay	Number of patients	Average stay	Number of patients	Average stay	Number of patients	Average stay
Moderately advanced	1946	10	516	5	110	2	233	17	363
	1947	21	307	8	74	1	54	30	237
	1948	15	299	12	216	0	--------	27	262
	1949	23	820	7	228	0	--------	30	682
	1950	17	496	4	195	2	821	23	472
	1951	21	390	1	481	2	984	24	444
	1952	18	495	4	224	1	73	23	429
	1953	20	261	2	299	2	72	24	249
Far advanced	1946	7	308	9	92	9	470	25	289
	1947	14	319	11	151	19	284	44	262
	1948	7	474	12	246	7	493	26	374
	1949	3	865	4	477	11	772	18	722
	1950	12	713	7	345	7	352	26	517
	1951	16	665	3	573	5	1, 153	24	755
	1952	19	847	2	115	6	740	27	769
	1953	22	844	3	229	7	787	32	774
All active pulmonary tuberculosis (including minimal).	1946	21	383	14	99	12	396	47	301
	1947	37	304	20	117	20	272	77	248
	1948	22	355	24	231	7	493	53	317
	1949	28	797	11	318	11	772	50	686
	1950	31	558	11	291	9	456	51	482
	1951	38	552	4	550	7	1, 104	49	631
	1952	39	653	6	188	7	644	52	598
	1953	43	557	5	257	10	566	58	533

Figure 2. Average duration of stay of tuberculosis patients discharged from Broadlawns sanatorium, 1946–53, by stage of disease on admission.

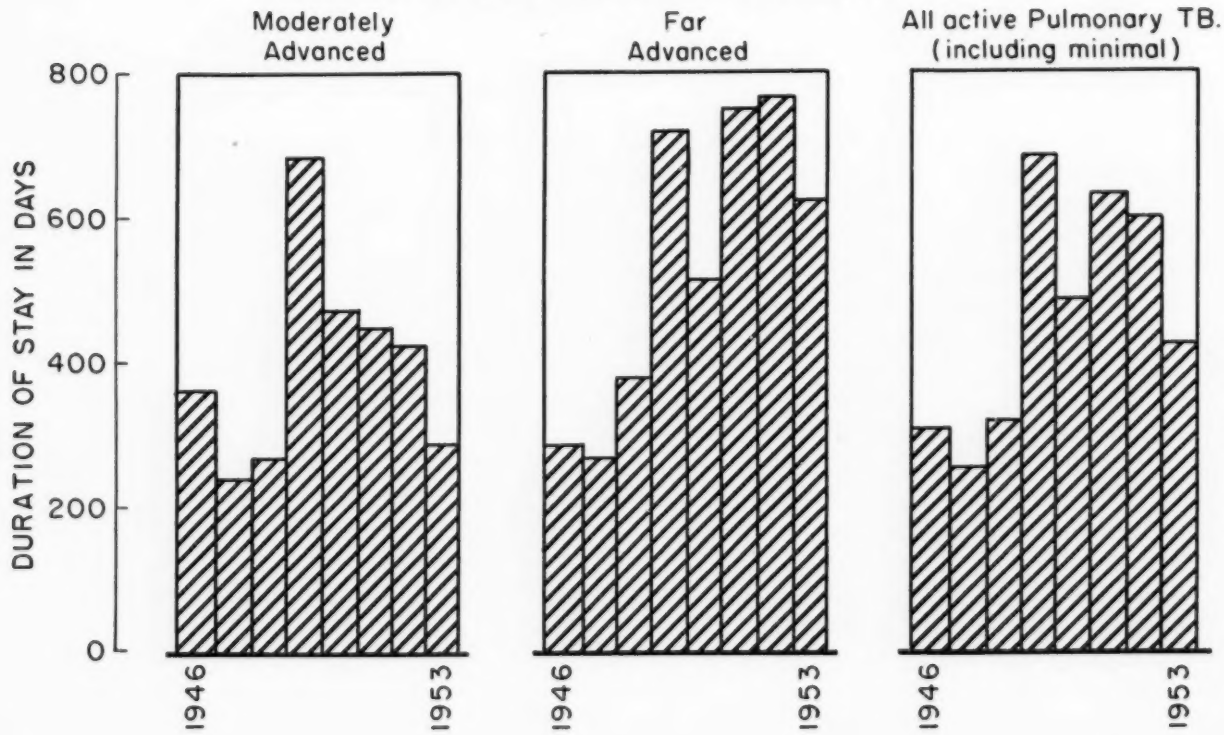
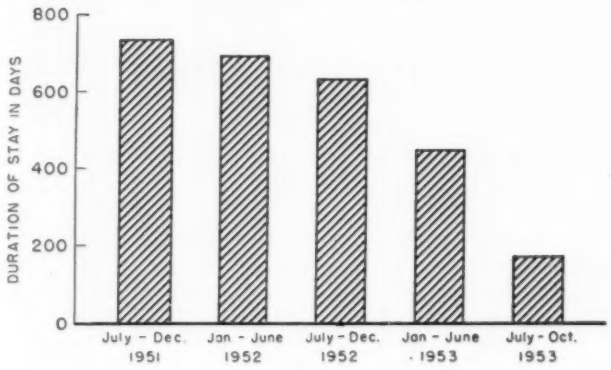


Figure 3. Average duration of stay in days for tuberculosis patients discharged to home care from Broadlawns sanatorium, 1951–53.



is the average duration of cases discharged to home care by 6-month periods since July 1951.

Period	*Number of cases*	*Average duration in days*
January–June 1951	2	----------
July–December 1951	12	733
January–June 1952	15	691
July–December 1952	12	632
January–June 1953	11	447
July–October 1953	14	170

It will be noted that declines are continuous and that those discharged in the last 4 months of 1953 had been in the hospital only about one-fourth as long as those discharged in the last half of 1951.

Summary

Recent years seem to have brought about an increase in the proportion of discharges "with advice" and a decrease in discharges as "dead" and "against advice." In 1953 over 70 percent of the discharges were "with advice" as compared to somewhat over 40 percent in 1946. This trend is much more pronounced in far advanced tuberculosis. Evidently the outlook is much more favorable now than formerly. This favorable outlook for tuberculosis patients admitted to Broadlawns Polk County Hospital, Des Moines, Iowa, has been accomplished at the expense of longer single hospitalization per patient, with large increases occurring about 1949. This longer hospitalization seems to be true both of those discharged with advice and those who died. The average duration of single hospital stay seems to have reached its peak in 1949 and may be declining for all tuberculosis as it appears to be for moderately advanced tuberculosis. No data are available regarding the total hospitalization throughout the tuberculous person's life.

Since 1951 a large proportion of patients discharged with advice have been placed on "home care." Persons with active tuberculosis in Des Moines are handled as are cases of other communicable disease and are closely supervised either in or out of the sanatorium. The duration of hospitalization of such home care cases has declined precipitously. The average stay of those discharged in the period July–October 1953 was less than one-quarter of that in 1951. This trend appears to be affecting the average duration of moderately advanced tuberculosis, which is now approximately half of what it was in the years 1949 and 1950 and as low as in the years 1946 and 1947.

In studying duration of single hospitalizations it is important to distinguish between what has happened since 1949 and what has happened since 1946. At Broadlawns, the recent declines for moderately advanced tuberculosis in duration of hospital stay—about half that of 1949, 1950, and 1951—have brought the average stay down to the level of 1946 and 1947.

The real gain in the hospitalization of tuberculosis patients has been the change from discharged "against advice" to discharged "with advice" and a decline in the case fatality rate.

Multiphasic Screening in a Health District Of Los Angeles

By STELLA B. SOROKER, M.D.

THE NORTHEAST health district of the Los Angeles City Health Department covers about 28 square miles and contains approximately 250,000 people in its varied communities. The district health center is in Boyle Heights, where industrial encroachment has been accompanied by deterioration and devaluation of residential property. Ethnic and religious groups in Boyle Heights include newcomers from Mexico and the displaced persons camps of Europe, who arrive daily to join friends and relatives and to start life anew within the area. Ambitious young people, who have attained a degree of economic security, move out of the area.

With this community deterioration attended by problems of low income, illness, and assimilation, Boyle Heights presented a challenge to our concepts of preventive medicine and health education. The pilot multiphasic screening project was one attempt by the Los Angeles City Health Department to meet this challenge.

Background

A local diabetes detection program was first suggested by the Eastside Community Health Council, whose members work or live in Boyle Heights and share a common interest in the community health. This suggestion eventuated in a multiphasic screening survey adapted by the northeast district health officer to the community's specific needs.

The Los Angeles City Health Department was familiar with multiple screening. The city's mobile X-ray unit was constructed with the intent of combining serologic tests for syphilis and X-ray examinations, and it had proved its worth in a tuberculosis-venereal disease survey in June 1950.

Coincident blood sugar determination was successfully employed with mass survey operations in Atlanta, Ga., and in Contra Costa County and San Jose, Calif. (*1–4*). Multiphasic screening procedures were recommended by the California Conference of Local Health Officers (*2*). Also, several large manufacturing concerns had requested the inclusion of diabetes detection in conjunction with the health department's X-ray and blood test screening procedures for workers.

Further, the Eastside Health Council members had gained experience with house-to-house canvassing as an effective means of promoting participation in community surveys during a previous local X-ray program.

Planning the Survey

Our objectives were twofold. The first was case finding through early detection and referral for further study and treatment of such conditions as tuberculosis, lung cancer, certain

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cardiac abnormalities, diabetes, anemia, obesity, and malnutrition.

The second objective was health education through increased community interest in prevention by periodic examination of chronic as well as acute diseases.

Four screening tests were selected: chest X-ray, blood sugar, hemoglobin, and height-weight determinations.

As a survey of the entire Boyle Heights area was a physical impossibility, operations were to be limited to 3 census tracts with an eligible population of 13,751. The population was known to have a high incidence of tuberculosis, many aged, and, according to local medical opinion, a large number of diabetics.

Based on the response of 45.8 percent of the area's eligible population to the countywide chest X-ray survey in 1950, and the known tuberculosis rate, it was estimated that approximately 6,000 persons should participate in the survey, and that 9 new cases of tuberculosis would be found. Similarly, basing our figures on the 1.4 percent high blood sugars screened in the Contra Costa survey (*2*), we expected to find at least 84 diabetes suspects of whom one-half would be unaware of their disease. An even higher percentage of diabetes might be discovered among relatives of the known diabetics, the obese, and the aged in this selected population.

The project was set for a 20-day period in March 1952. Twenty-eight sites within 3 blocks of every resident of the area were selected. Volunteers were assigned areas around each site for house-to-house canvassing.

The bureau of chronic diseases of the California State Department of Public Health aided in the planning, provided the district officer with invaluable consultation services, and loaned a Hewson Clinitron (A) plus some glassware.

Under direction of the bureau of medical services of the Los Angeles City Health Department, the division of tuberculosis control assigned the mobile X-ray unit and personnel to Boyle Heights for the duration of the survey, helped word the form letters on tuberculosis, and provided for rapid reading of minifilms. The coordinator of laboratory services requisitioned laboratory supplies and equipment as needed, coordinated assignment of supplies from State and city, assigned laboratory technicians, and supervised technical laboratory procedures. The director of the nutrition division assigned a nutritionist and provided consultation to the examiners on the height-weight evaluations.

William Pote, M.D., member of the American Diabetes Association and head of the diabetic clinic at the White Memorial Hospital, accepted an appointment as diabetes consultant on followup procedures and evaluation.

Alerting the Public

The Los Angeles County Tuberculosis and Health Association, cosponsors with the Eastside Community Health Council of the survey, provided campaign literature and posters as well as the part-time services of two field representatives and an experienced public health nurse.

An explanatory leaflet entitled "This Is For You" was given each pupil in the three elementary schools located in the survey area to acquaint the parents with the purpose and schedule of the survey.

East Los Angeles Junior College students reported daily for volunteer assignments. Six hours of verified volunteer work substituted for certain previously required term papers or homework in their health classes.

Churches announced the survey at services. Aliso Village Health Study Club members assumed responsibility for canvassing and registering in their public housing project, thus translating health study into positive action.

Following orientation, medical and nursing students from the College of Medical Evangelists (White Memorial Hospital) were assigned to observe and to participate in the program as part of their public health courses. In addition to their canvassing activities, many visited the unit and received the entire battery of screening tests.

The district health officer called on local practicing physicians to inform them of the survey, its purpose, schedule, followup, and referral plan. Physician response was uniformly favorable, particularly to diabetes case-finding possibilities.

The project was brought also to the attention of local hospitals, since these would undoubtedly receive referrals of suspects found in the survey.

Orientation on medical, laboratory, and control aspects of diabetes at the monthly meeting of district public health nurses featured the film "Story of Wendy Hill" (B) and a talk by our diabetes consultant. The film tells about one of the unknown diabetics and how serious the disease can become if neglected.

Table 1. Response of selected population, northeast health district of Los Angeles

Population and type of test	*Number*	*Percent*
Total	18,831	100.0
Total eligible [1]	13,751	73.0
Total tested	3,203	23.3
Chest X-ray	3,203	23.3
Blood sugar	2,856	20.8
Blood hemoglobin	2,840	20.7
Height-weight	2,860	20.8

[1] Over 15 years of age.

Front page publicity was obtained in the two local newspapers through press conferences with the editors and news releases submitted to them personally.

Operations

Despite rainy weather during much of the survey, 3,203 persons, 23.3 percent of the eligible population, passed through the mobile unit at its various locations for a total of 11,759 screening tests (table 1).

In addition to the original staff consisting of unit coordinator, technician-driver, and medical investigator, the following personnel were loaned for mobile unit operations: one full-time laboratory technician from the division of laboratories, one half-time laboratory technician from the southeast health district, a part-time nutritionist from the nutrition division, and a medical investigator from the central venereal disease clinic for epidemiological case finding and followup.

When completely staffed, the mobile unit operated from 11 a. m. to 7 p. m. daily, and processed each visitor in about 5 minutes. The first step was the completion of a self-addressed post card for notification if all four tests were negative. Patients were then registered on 2 separate punchcards, 1 for tuberculosis and 1 for diabetes, hemoglobin, and height-weight screening. Two questions were asked, the second in order to decide screening levels for blood sugar determination: "Do you have diabetes?" "Have you had anything to eat or drink in the past 2 hours?"

The visitors received a chest X-ray. Next, capillary blood samples for hemoglobin and for blood sugar determination were taken. Height and weight were recorded last. An explanatory pamphlet entitled "Congratulations" was given each person before leaving.

A messenger delivered blood sugar samples to the central laboratory twice daily and returned reports.

Screening Techniques and Findings

Minifilms (70 mm.) were read at the district health center by chest clinic physicians. Of the 3,140 persons whose films were technically satisfactory, 118, 3.8 percent, were found to be suspects; 75 were classified as possible tuberculosis; 23 as other pathology, and 20 as cardiac.

Table 2. Screening test results, northeast health district of Los Angeles

Type of test	*Number*	*Percent*
CHEST X-RAY		
Total	3,203	100.0
Unsatisfactory films	63	2.0
Total satisfactory films	3,140	100.0
Suspects	118	3.8
Possible tuberculosis	75	-------
Cardiac	20	-------
Other chest pathology	23	-------
Normal	3,022	96.2
BLOOD SUGAR DETERMINATION		
Total screened	2,856	100.0
Technically unsatisfactory results	29	1.0
Total satisfactorily screened	2,827	100.0
Screened positive	87	3.1
Previously known diabetic	26	-------
Previously unknown diabetic	61	-------
Screened negative	2,740	96.9
Previously known diabetic	23	-------
First screening	2,717	-------
BLOOD HEMOGLOBIN DETERMINATION		
Total	2,840	100.0
Abnormal (low)	233	8.2
Normal	2,570	90.5
No record	37	1.3
HEIGHT-WEIGHT EVALUATION		
Total	2,860	100.0
Overweight	1,073	37.5
Underweight	90	3.1
Normal	1,697	59.4

Table 3. Confirmatory test results on suspects found in the northeast health district of Los Angeles

	Number	Percent
CHEST X-RAY		
Total tuberculosis suspects	75	100.0
Patients notified	75	100.0
Patients reporting	64	85.3
Patients reporting	64	100.0
Minimal	23	
Active	2	
Inactive	19	
Arrested	2	
Moderately advanced	6	
Active	4	
Activity undetermined	2	
Far advanced	1	
Inactive	1	
Other tuberculosis	1	
Primary, healed	1	
Other chest pathology	6	
Diagnosis unknown	8	
Deferred diagnosis	2	
Under care, private physician	5	
Under care, central chest clinic	1	
Essentially negative	19	
Previously known to health department	8	
Minimal inactive	4	
Minimal arrested	2	
Moderately advanced, active	1	
Other chest pathology	1	
Previously unknown to health department	56	
Total other chest pathology suspects	23	100.0
Patients notified	23	100.0
Patients reporting	18	78.3
Patients reporting	18	100.0
Other pathology (bronchiectasis, possible cancer, emphysema, pleurisy, etc.)	5	
Diagnosis unknown	2	
Under care private physician	2	
Essentially negative	11	
CHEST X-RAY—Continued		
Previously unknown to health department	18	
Total cardiac suspects	20	
Patients notified to seek other diagnostic facility	20	
Patients reporting to city health department	3	
BLOOD SUGAR RECHECK		
Total diabetes suspects	87	
Patients notified	87	100.0
Patients reporting	76	87.4
Number tests done	72	82.7
Previously unknown positives retested	55	
Retested positive (fasting and 2 hours post sugar ingestion)	16	
Retested positive (2 hours post sugar); negative (fasting)	16	
Retested negative (fasting and 2 hours post sugar)	23	
Previously known positives retested	17	
Retested positive (fasting only)	10	
Retested negative or under control (fasting only done)	6	
Retested technically unsatisfactory	1	
HEMOGLOBIN RECHECK		
Total low hemoglobin suspects	233	
Patients notified	224	
Patients reporting	142	63.4
Abnormal (Sahli 11.2 gm. or 68.75 percent or below)	30	21.1
Normal	112	78.9
HEIGHT-WEIGHT DETERMINATION		
Total (overweight and underweight)	1,163	
Patients notified	1,163	
Patients reporting	192	16.5

Three thousand and twenty-two persons, 96.2 percent, were found essentially normal. The films for 63, 2 percent of the 3,203 persons screened, were technically unsatisfactory (table 2).

Blood sugar specimens were screened by Clinitron (A) at 130 and 180 mg. percent glucose, depending on recency of food ingestion. Of 2,827 persons with satisfactory tests, including 49 previously known diabetics, 87, 3.1 percent, had abnormally high blood sugar levels. Of these 87, 26, approximately 30 percent, were previously known diabetics.

Blood hemoglobin determination was done on the spot using the copper sulfate specific gravity test with screening levels at 11.0 gm. and 12.3 gm. per 100 ml. of blood for females and males, respectively. Of the 2,840 persons tested, 233, 8.2 percent, had hemoglobin concentrations below the screening level selected.

Height-weight measurements were featured to spotlight obesity as a public health problem, particularly as related to diabetes. Of 2,860 persons evaluated on the basis of optimum weight for height and body build (according to Metropolitan Life Insurance Company tables), 1,073, 37.5 percent, were classified as 10 percent or more overweight and 90, 3.1 percent, were classified as 10 percent or more underweight.

Followup

Results of these screening procedures were tabulated daily. Notification of those entirely negative began before the conclusion of survey operations. Scheduling appointments to the retake clinics at the health center for secondary screening of those with abnormalities occupied the full time of a medical investigator and frequently completely bogged down the normal functioning of our clerical staff.

Response and Results

Chest X-ray recheck, using 14-inch by 17-inch film, plus further diagnostic procedures when indicated, followed routines already in operation, with resultant temporary overloading of our crowded tuberculosis clinics.

Sixty-four, 85.3 percent, of the tuberculosis suspects notified, reported for recheck. Tuberculosis was diagnosed in 30, 46.9 percent, of whom 6 were classified as active, 20 as inactive, 2 as arrested, and 2 as activity undetermined. Five of those designated as active were not aware of this condition and were previously unknown to the health department. The sixth was returned to medical supervision. Essentially negative diagnoses were made in 19 cases (table 3).

Eighteen, 78.3 percent, of the persons with other chest pathology reported to our clinics for further workup. Five were found to have such conditions as bronchiectasis, emphysema, pleurisy, and possible cancer.

Those 20 persons in whom a possible cardiovascular abnormality was noted were referred by letter to their private physician or clinic for further study.

The 63 persons whose films were found technically unsatisfactory were referred to the nearest clinic or mobile unit for another film.

Confirmatory blood sugar tolerance tests in fasting state and 2 hours after controlled carbohydrate intake were run on 72, 82.7 percent, of those found to have high blood sugar on previous screening. Of the 55 previously unknown as diabetics, 16 were found to have abnormal blood sugar metabolism and an additional 16 were classified as borderline or potential diabetics. Twenty-three, or about one-third, had normal blood sugar levels (table 3).

Table 4. Referral and followup results of screening of diabetics in northeast health district of Los Angeles

	Number	*Percent*
Confirmed high blood sugar referred to private physician or clinic for diagnosis	42	1.5
Diagnosis reported by physician or clinic	31	1.1
Previously unknown diabetic:		
Not diabetic	4	-------
Clinic	*1*	-------
Private physician	*3*	-------
Is a diabetic	16	-------
Clinic	*10*	-------
Private physician	*6*	-------
Diagnosis established prior to this survey by private physician	3	-------
Record incomplete (as of Sept. 22, 1952)	9	-------
Total	32	
Previously known diabetic:		
Had lapsed from regular medical care and made at least one visit to the clinic as a result of the survey	3	-------
Has been following medical advice for the control of diabetes with reasonable regularity	5	-------
Clinic	*2*	-------
Private physician	*3*	-------
Record incomplete (as of Sept. 22, 1952)	2	-------
Total	10	-------

SUMMARY

Total cases diabetes diagnosed	27	1.0
Previously unknown diabetics	16	.6
Previously known diabetics	11	.4
Under care of clinics	15	-------
Under care of private physicians	12	-------
Record incomplete	11	-------

Among the 17 previously known diabetics whose blood sugar was rechecked after fasting, 10 were apparently inadequately controlled, 6 were probably under control, and 1 test was technically unsatisfactory. During the 2 hours after controlled carbohydrate intake, our district nutritionist led a group discussion on obesity and diabetes, a film (C) was shown, and questionnaires concerning diabetes were distributed and discussed.

The hemoglobin recheck clinics were attended by 142 patients, or 63.4 percent of those notified. Approximately one-fifth were found to have hemoglobins below 68.75 percent, or 11.2 gm. Sahli (table 3). A nutritionist was available for consultation with the patients.

Overweight persons were invited to a showing and discussion by the nutritionist of the film

"Cheers for Chubby" in order to motivate them to seek a change in diet pattern. Only 192, 16.5 percent, responded (table 3). Those found underweight were also given the opportunity for consultation with our nutritionist.

Referrals

Referrals of those diagnosed as tuberculosis and other chest pathology followed established health department policy.

The 42 diabetes suspects, after second screening, were referred to physicians or clinics of their choice for further study. Form letters containing laboratory results were sent the respective physicians or clinics, and a report of the final diagnosis was requested.

When no report was forthcoming, our public health nurses made home calls to encourage patient followup in some cases. In others, physicians were contacted by phone.

Those with low hemoglobin on recheck were given a referral to the physician or clinic of their choice. Those with weight discrepancies were urged to check with their family doctors or clinics. A series of group weight control sessions with a nutritionist leader and medical social worker is under consideration for overweight persons who obtain medical recommendation.

Evaluation

As a health education measure, the program utilized and extended the residual community enthusiasm and knowledge from previous tuberculosis surveys. Similar results may confidently be expected in the future. We already have received requests for this type of survey from other sections of the community.

Furthermore, physicians, medical schools, clinics, public schools, and churches in the area have been alerted to the public health significance of diabetes and obesity and to this relatively new method of case finding cosponsored by health department, health council, and tuberculosis association. Our followup with physicians as regards diagnostic criteria was inadequate, chiefly because we relied on individual rather than group contact.

Although only half as many people responded as we had anticipated, reports to date from clinics and private doctors indicate that the survey may be credited with:

Six newly diagnosed cases of active tuberculosis (1.8 per 1,000 participants); 5 newly diagnosed "other pathology" such as emphysema, bronchiectasis, pleurisy; 16 newly diagnosed diabetics (6 per 1,000); 3 previously known diabetics returned to treatment; and 30 persons with abnormally low hemoglobins referred to clinic or private care (11 per 1,000); 1,073 (37.5 percent) obese individuals informed as to significance of this condition; and 90 (3.1 percent) underweight persons advised to seek further examination.

At first glance, mass survey methods appear costly. However, in contrast to the pyramiding cost of hospitalization, often at public expense, and rehabilitation plus financial aid to dependents, the economies of screening become apparent if preventive or corrective action ensues.

Personnel was insufficient. All concerned worked to the limit of their capacities. Illness, sharing of staff with other projects, and personal business—all took their toll. Staff members frequently went without meals because no substitutes were available. Occasionally, people grew discouraged when the waiting line became too long and left without completing the entire battery of tests.

We now realize that two full-time laboratory technicians were essential. A dry run should have been held to check on operations and permit the laboratory technicians to develop speed and accuracy. One full-time person should be responsible for volunteer relationships and another for recordkeeping and notification. Extra clerical help must be included in mass survey plans.

Morning hours were not practical, whereas late afternoon and evening hours yielded the best results.

Conclusion

Health agencies, private physicians, and public alike are giving increased attention to early detection as the basic long-range approach to the chronic disease problem. Although cost studies have not been completed—based on the experience gained from this pilot cooperative

effort in the northeast health district—adequately planned, short-term, intensive multiphasic surveys in selected high-incidence census tracts or limited areas should be encouraged as effective health education and case-finding tools.

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(*1*) Petrie, L. M., Bowdoin, C. D., McLoughlin, C. J.: Voluntary multiple health tests. J.A.M.A. 148: 1022–1024 (1952).

(*2*) Milmore, B. K.: Diabetes control activities in California. California's Health 9: 57–60 (1951).

(*3*) Breslow, L.: Recent developments in multiphasic screening. California's Health 8: 89–90 (Dec. 1950).

(*4*) Milmore, B. K.: The problem of diabetes. California's Health 7: 41–43 (Sept. 1949).

EQUIPMENT REFERENCES

(A) Hewson Clinitron, Mathewson Machine Works, Inc., Quincy, Mass.

(B) The Story of Wendy Hill. Sound, color, 16 mm., 20 minutes, 1949. Available through the California State Department of Public Health and the American Diabetes Association. For high school, college, adult, and training groups. Cleared for television.

(C) Cheers for Chubby. Sound, color, animated, 16 mm., 8 minutes, 1951. Produced by the Metropolitan Life Insurance Co. in cooperation with the Public Health Service and the American Medical Association. Available through the Metropolitan Life Insurance Co. For high school, college, and adult groups and also for professional personnel.

Applications for Research Awards

Applications for research awards to be made for periods beginning July 1, 1955, by the American Heart Association and its affiliates are now being accepted. Applications for research fellowships and established investigatorships may be filed up to September 15, 1954. Applications for research grants-in-aid will be accepted up to December 1, 1954.

Established investigatorships, awarded for 1- to 5-year periods subject to annual review, range from $6,000 to $9,000. They are available to scientists of proved ability who are engaged in a research career. Research fellowships, awarded for 1- to 2-year periods, range from $3,500 to $5,500 and enable scientists to train for research careers under experienced supervision. Grants-in-aid are awarded in varying amounts, usually not exceeding $10,000, for periods of 1 to 3 years, to experienced scientists working in nonprofit institutions on specified programs of research.

Additional information and application forms may be obtained from: Medical Director, American Heart Association, 44 East 23d Street, New York 10, N. Y.

Athletics for Health

As a result of a study of school athletics, the Education Policies Commission of the National Education Association of the United States and the American Association of School Administrators has drafted comprehensive recommendations. The summary of these recommendations, adapted for publication in Public Health Reports, is presented here for the benefit of public health officials who may be called upon to evaluate safety factors, physical and emotional stresses of competitive sports, and the implications for health education and constructive recreation when these recommendations and associated issues are discussed.

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Athletics can, and do, serve valuable purposes in school programs. Too much of the educational potential in school athletics, however, is unused or misused. Evils are, rightly, much criticized; but these are to be found in abuses in practice and not in the essential nature of athletics.

Neither the teaching profession nor the general public should remain silent when sports programs serve purposes contrary to desirable educational objectives. The community should not permit any pressures to divert school athletics from the objectives of good education. Schools must make every effort to conduct their athletic programs in ways that will do the most good for children and youth.

Each school or school system should identify clearly the goals it seeks for its athletic program. School personnel should invite the cooperation of students and other citizens in identifying these goals.

All children and youth should share in the benefits of athletic participation. School programs should be so planned that every pupil may have athletic experience.

From School Athletics, Problems and Policies; Washington, D. C., National Education Association, 1954, chapter 11, pp. 81–84.

At all grade levels, elementary and secondary, the curriculum should include broad programs of physical activities in the form of organized games and sports. These programs should be conducted by teachers on the regular school staff and should be under the control of school authorities. In these respects, school athletics should be no different from other parts of the instructional and activity program of a school.

Athletic activities should fit harmoniously into the rest of the school program with respect to purposes, schedules, budgets, and demands on the time and attention of students and staff. Athletic activities should be conducted as part of physical education under the direction of teachers with special preparation in the field of physical education.

The Core of the Program

Programs of athletic education will succeed in proportion to the extent to which they are infused with variety and appeal, matched to the varying needs and interests of different children, scheduled to permit maximum participation, and supported with adequate funds, facilities, and leadership.

The core of the program at all levels should be the athletic instruction and play for all pupils in regular classes in physical education. (The total program in physical education, of course, includes many other things than athletics, both in physical education classes and in out-of-class activities. . . . The scope of this statement is confined to school athletics, here defined as "all school-sponsored physical activities in the form of competitive games or sports in which students participate.") This required program should be supplemented by games and sports that enlist participants on a voluntary basis. The out-of-class, voluntary program should be informal and casual in the lower grades, but increasingly organized at upper levels.

For the most part, at all levels, pupils should compete only with schoolmates, but occasionally there might well be provided opportunities—available to all pupils—to play with and against pupils of other schools in such informal extramural activities as play days and sports days.

Interscholastic competition should be permitted only in senior high school. In elementary school and in junior high school, there should be no "school team" (in the varsity sense), no leagues, no tournaments, no interschool championships. In senior high school, there should be no postseason championship tournaments or games.

Athletic games, in all cases, should be played with emphasis on fun, physical development, skill and strategy, social experience, and good sportsmanship. High-pressure competition, with overemphasis on the importance of winning, should not be sanctioned in any part of the school program. When such competition is promoted for children and youth outside the school's jurisdiction, school personnel should not only refuse to give it their sanction but should also exert leaderhip in the community to bring about better understanding of what constitutes desirable athletic experience for young people.

Wise Leadership at All Levels

Danger of overindulgence in competitive sports is perhaps greatest at junior high school level, where wise leadership and careful guidance are critically needed to prevent physical and emotional injury to young adolescent boys. Strong pressures sometimes must be resisted—pressures from divers sources: out-of-school promoters, recruiters of "material" for senior high school varsity teams, parents who desire athletic stardom for their sons. Pressures from the boys themselves—driven by altogether natural desires to grow up, to emulate older boys, and to achieve recognition—must also be curbed.

Boxing should be taboo at all school levels. Ice hockey and tackle football should not be played below senior high school. Girls should not engage in body-contact sports at all.

Boys and girls, in all grades, should have opportunities to play together in a variety of sports. Beginning with junior high school, the distinctive needs of the sexes call for recognition. In senior high school, boys and girls should be separate for much the larger part of the athletic program, but there should be considerably more co-recreation at that level than is to be found in prevailing practice.

Girls should share equally with boys in facilities, equipment, and funds allocated to athletic activities in junior and senior high school. But girls' athletic activities should not be imitations of those for boys. They should play according to girls' rules.

Boys' interscholastic athletics should be governed by the same authorities that control other parts of the school program, at both local and State levels. A State high school athletic association should function under the authority of, and within a framework of policies established by, the legally constituted educational agency of the State government.

Local school authorities should give consistent support, in letter and in spirit, to the rules and standards developed by the several State high school athletic associations and by similar bodies. They should acquaint members of boards of education, sportswriters, and other citizens with these rules and standards; develop community understanding of the reasons for them; and resist pressures for practices that would violate them.

State departments of education should become increasingly active in efforts to focus attention of educators and laymen on the needs for desirable educational objectives and effective controlling policies for interscholastic athletics.

Boards of education should establish policies for financial support of interscholastic athletics that will free the interscholastic program from dependence on gate receipts. School and community leaders should make every effort to finance athletics completely out of general school funds at the earliest possible date.

A school's athletic activities should be in harmony with the rest of the total school program with respect to aims and outcomes. Athletic activities should synchronize with the rest of the educational enterprise in matters of schedules, responsibilities of the school staff, demands on the time and energy of students, and allocation of space and facilities. Funds provided for athletics should be generous, but not at the expense of other educational essentials. In short, a school's program in athletics should in all respects be kept in sound proportion to the total school program.

technical publications

Care of the Long-Term Patient

Source book on size and characteristics of the problem

Public Health Service Publication No. 344. 1954. By G. St.J. Perrott, Lucille M. Smith, Maryland Y. Pennell, and Marion E. Altenderfer. 123 pages; tables. 60 cents.

This source book is a compilation of statistical information assembled for the use of participants in the National Conference on Care of the Long-Term Patient. It consists of 69 tables, each group of tables being preceded by a brief descriptive analysis. In addition to information from published sources, this compilation includes a large volume of hitherto unpublished data. Special analyses were prepared from data obtained by several agencies in their own reporting programs. Other tabulations are summaries of material collected by study groups preparing background information for the conference.

The estimated number of persons with long-term disabling chronic disease or impairment in the United States was 5.3 million in 1950, about 3.5 percent of the total population. Excluded from this frame of reference are approximately 23 million other persons whose impairments resulting from chronic disease, injury, or congenital anomaly are minor or nondisabling—conditions for which short-term care is ordinarily available in most communities.

The estimated number of long-term patients in the civilian noninstitutional population is 4.2 million, or 79 percent, of the total with long-term disability. Hospitals for long-term care—mental, tuberculosis, and chronic disease—account for 14 percent; homes and schools for the mentally handicapped, for the physically handicapped, and for the aged and dependent, another 7 percent. Almost 2.1 million of the long-term patients are in the older age group, 65 years and over; about 1.8 million are age 45–64 years, and 1.4 million are under 45 years.

Topics discussed under the heading of the patient at home are home-care programs of general hospitals, homemaker services, nursing services, and foster home placement service. Data on the patient in an institution cover all types of hospitals—general and allied special, mental, and tuberculosis, as well as nursing and convalescent homes, homes for the aged, and homes and schools for the mentally and physically handicapped. Integration of facilities and services relates to community welfare councils, national voluntary health agencies, regional health service programs, and counseling and referral services. Appendixes show the location of rehabilitation centers, non-Federal chronic disease hospitals, and chronic disease units of 10 or more beds in non-Federal general hospitals.

A Comprehensive Program for Water Pollution Control for the St. Croix River Basin

Water Pollution Series No. 60. Public Health Service Publication No. 335. 1953. 8 pages. Available from the Minnesota State Pollution Control Commission, the Wisconsin State Committee on Water Pollution, and the Upper Mississippi and Great Lakes Drainage Basins Office.

This document is one of a series presenting comprehensive pollution abatement programs developed by the States and adopted by the Surgeon General of the Public Health Service in accordance with the Water Pollution Control Act.

The State water pollution control agencies of Minnesota and Wisconsin have cooperated in establishing a comprehensive program designed to correct pollution conditions in the St. Croix watershed. The essential elements of the program are outlined in this publication.

The St. Croix River rises in Upper St. Croix Lake, Douglas County, Wisconsin, and flows in a southerly direction 164 miles to the Mississippi River. It drains 3,250 square miles of eastern Minnesota and 4,400 square miles of northwestern Wisconsin. There are 33 sewered municipalities and institutions with a total connected population of about 43,000 in the basin. Twenty-five of these municipalities are served with treatment facilities although 7 of the 25 are reported to have inadequate capacity. The 8 remaining communities discharge sewage directly to the stream without treatment.

The major use of surface water in the basin is for recreational purposes. All public water supplies are obtained from ground sources. Although the area is predominantly rural, the agricultural yield is low and many residents have developed recreational facilities to attract tourist and vacation trade for supplemental income.

Despite abatement progress made in this basin, there is still considerable pollution, due to the fact that the municipal sewers carry a considerable industrial waste load in addition to the load of the actual population served by sewers.

Concepts of Radiological Health

Public Health Service Publication No. 336. 1954. 48 pages; illustrated. 45 cents.

The major goals of radiological health are to prevent impairment of human well-being from exposure to injurious ionizing radiations and to promote better health through the beneficial use of radiation, radiation-producing machines, and radioactive substances.

This manual brings together viewpoints and basic information perti-

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nent to the practice of radiological health and has been prepared to serve as a source book for Public Health Service regional consultants in preparing short lectures and brief courses in radiological health.

The subject matter has been divided into three parts: I. Radiation Production and Absorption; II. Biologic Effects of Radiation Absorption; III. Radiological Public Health. This publication contains parts I and II. Part III is in process of preparation.

Part I covers radiation as a public health problem; atomic physics and isotope-produced radiations; machine-produced radiation; and absorption of ionizing radiation.

Part II discusses how radiation initiates changes in living tissues; units of radiation and radioactivity; biologic effects of radiation; and radiological health implications.

Appendixes include a glossary of radiation and biological terms; list of elements; masses of the known isotopes; and comparison of properties of selected radioisotopes.

Proceedings of the Third Conference of Mental Hospital Administrators and Statisticians

Public Health Service Publication No. 348. 1954. 133 pages; charts and tables. 65 cents.

The third annual Conference of Mental Hospital Administrators and Statisticians, with representatives from 15 States, met in Washington, D. C., April 15–17, 1953, to discuss developments in mental hospital statistics and to explore methods of obtaining more adequate data on the mentally ill in hospitals and outpatient clinics.

Résumés of the principal addresses and reports from the member States, now forming the "model reporting area for mental hospital statistics," are given in the publication together with charts and tables illustrating the studies made of data gathered from mental hospitals.

In summarizing this conference and in mentioning the work of the two previous conferences, the report points out that statistical methods, when properly used, allow the objective presentation of needed data to determine what is being done and what is being achieved. Individual States are now showing considerable activity in trying to get meaningful data on what is going on in mental hospitals and in clinics, according to the report.

Plans for the next conference, proposals for financing the meeting, and suggestions for interim committee work to develop and evaluate tabulations and methods of analysis are reported.

Salaries of State Public Health Workers, August 1953

Public Health Service Publication No. 340. 1953. 55 pages. Prepared in cooperation with the Association of State and Territorial Health Officers and the American Public Health Association.

The data for this study, the seventh in the annual series, were obtained from State health department payrolls for August 1953. Payroll and work titles were used in classifying the types of personnel included in the study. Only full-time professional personnel in the following classifications are reported: medical, nursing, sanitary engineering, sanitation, nutrition, health education, statistical, laboratory, business management, dental, and veterinary.

Data on salaries paid State health officers, five selected nonmedical program directors, and personnel in the groups listed above are presented by bar graphs and, in more detail, by tables.

Caution should be observed in interpreting comparisons of salaries between States. The organizational patterns, the responsibilities of individual positions, and qualifications of incumbents vary greatly from State to State. For example, several of the directors of vital statistics have broad responsibilities as chief statisticians for their entire health departments in addition to the responsibility for the collection and registration of vital statistics. The data are collected primarily for the purpose of charting and reporting currently on general salary trends. In line with this general purpose the detailed information is published to give State officials a broad view of their situation in relation to national averages.

Shellfish With Certificates

Public Health Service Publication No. 350. 1954. 1-fold leaflet; illustrated. $1.50 per 100.

A certificate number is placed on every container of fresh or frozen oysters, clams, or mussels coming from a clean State-inspected plant. The public is advised to find the certificate number on the container before buying shellfish, and, if certified shellfish cannot be found, to check with local or State health departments.

This section carries only announcements of all new Public Health Service publications and of selected new publications on health topics prepared by other Federal Government agencies.

Publications for which prices are quoted are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Public Health Service, Washington 25, D. C.

The Public Health Service does not supply publications issued by other agencies.

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